



IDEAS FOR INNOVATION

INFOGRAPHIC PORTFOLIO

SECOND EDITION

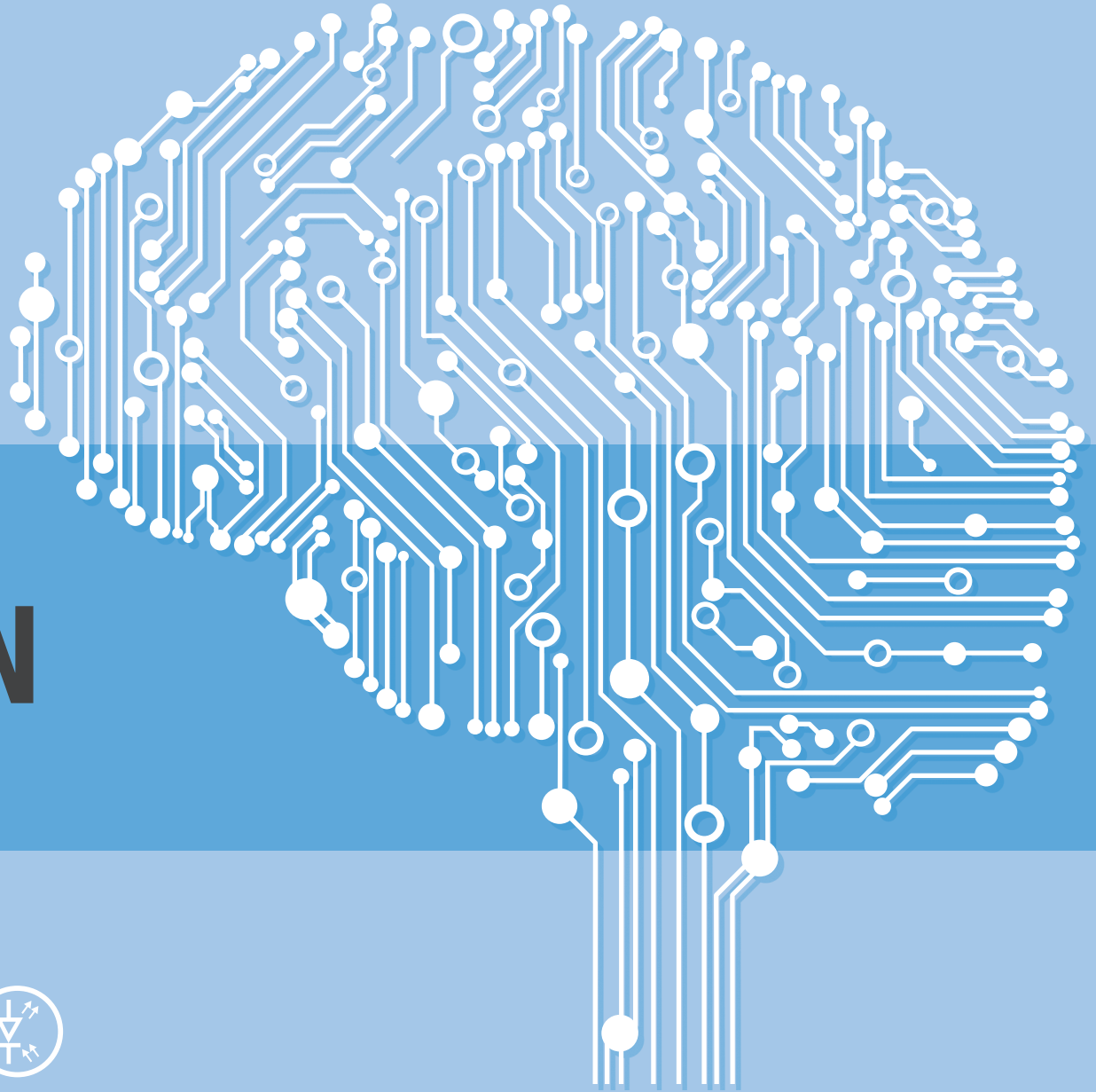




TABLE OF CONTENTS

CAPACITORS

3	196 HVC ENYCAP™ Hybrid Energy Storage Capacitors
4	220 EDLC ENYCAP™ Energy Storage Capacitors
5	High Temperature Aluminum SMD, Radial, and Axial: +125 °C and +150 °C
6	Snap-In Aluminum Capacitors 4-Terminal Snap-In DC-Link Solutions
7	DC-Link Film Capacitors Low ESR, High Ripple Current Capabilities
8	THB AC Filtering Capacitors Robust Design for High Humidity Environments
9	LVAC Power Capacitors, Triangular Low Loss MKP Technology, ESTAspring Connection
10	LVAC Power Capacitors, Cylindrical Low Loss MKP Technology
11	HDMKP Power Electronic Capacitors High Current, Low Inductance
12	RFI Capacitor Solutions Film and Ceramic Capacitors
13	Ceramic RF Power Capacitors Plate, Pot, and Barrel Types
14	High Voltage Ceramic Capacitors Radial Leaded, Single Disc
15	Vishay Automotive Grade Ceramic Safety Capacitors Leaded Single Disc and SMD MLCCs

16	Radial Leaded Automotive MLCCs High Operating Temperature, Up to 200 °C
17	RF Multilayer Ceramic Chip Capacitors RF and High Frequency Capacitors
18	MAP Polymer Capacitors High Energy Density Capacitors
19	Polymer Capacitors High Capacitance, Low ESR Capacitors
20	Automotive Grade Tantalum Capacitors High Performance, High Temperature
21	High Energy Wet Tantalum Capacitors High Capacitance, High Performance

INDUCTORS

22	IHLE High Current Inductors Integrated E-Field Shield
23	IHLP® Power Inductors Low Profile, High Saturation
24	SGIHLP™ Power Inductors MIL-STD-981 Class S Compliant
25	MGDT Planar Transformers Gate Drive Transformers, Drive High Side MOSFETs and IGBTs
26	MTPL Planar Transformers High Power Density, Designed to Meet MIL-PRF-27

RESISTORS

27	Carbon Film MELF Resistors High Pulse Load Capability
----	--

28	MELF Resistors For Pulse Load Applications
29	Low Ohmic MELF Resistors Precision Current Measurement MELF Resistors
30	Current Sense Resistors For Battery Management and Safety
31	WSK, WSLF, WSHP Current Sense Resistors High Power Density, Low Resistance
32	WSLP Current Sense Resistors High Power, Low Resistance
33	WSL Current Sense Resistors High Power, Low Resistance
34	High Power Thin Film Resistors Excellent Stability in High Power Applications
35	Thick Film Power Resistors AEC-Q200 Qualified Power Resistors
36	Wide Terminal Thin Film Resistors High Power, Space Saving
37	CDMM Chip Dividers High Voltage Molded
38	CDMx Chip Dividers High Voltage Molded
39	Thick Film Power Resistors High Power Compact Thick Film Resistors
40	RCP, PHP, PCAN High Power Resistors
41	Fusible Safety Wirewound Resistors Silent and Safe Fusing, Surge Handling Up to 6 kV

42	Resistor Arrays Wherever a Stable Resistance Ratio is Required
43	Water-Cooled Wirewound Resistors Ultra High Power Integrated Resistors
44	CRHV, CRMV Series High Voltage Thick Film Resistors
45	Electro-Pyrotechnic Initiator Chip Resistor SMD Ignitors
46	UIPMA, UFPMA Position Sensors Ultra Thin, Waterproof, Linear, and Angular
47	P11 Potentiometers Modular Panel Controls
48	NTC LUG Thermistors Surface Temperature Sensors
49	NTCC200 Thermistor Die Wirebondable for IGBT Modules
50	NTCLE Leaded Thermistors Epoxy Coated Radial, NTC
51	NTCS SMD Thermistors SMD Glass Protected, Sn Terminations

DIODES / RECTIFIERS

52	FRED Pt® Rectifiers eSMP® Series Packages Space-Saving Footprints and Low Profile Package Solutions for all Major Applications
53	FRED Pt® Rectifiers in SlimDPAK (TO-252AE) Increased Power Density and Improved Thermal Performance
54	FRED Pt® Rectifiers Offer Higher Power Density in Low Profile SMPD Package
55	FRED Pt® Rectifiers in FlatPAK 5 x 6 Increase Power Density and Performance

56	TMBS® Rectifiers in eSMP® Series Space-Saving Footprints and Low Profile Package Solutions
57	eSMP® SERIES Small and Low Profile Package Solutions for Select Diodes and Rectifiers
58	Standard Recovery Rectifiers With ESD Capability Low Profile eSMP® Series Packages
59	TRANSZORB® TVS - Offer Tighter Breakdown Voltage Tolerance ± 3.5 % in SMB Package
60	VTVS Series 400 V TVS in SMF Package Feature Accurate 2 % Breakdown Voltage Tolerance
61	TVS in eSMP® Series Packages TRANSZORB® and PART® VS
62	ESD Protection Diodes Ultra Compact Chip Level Packages (CLP)
63	PLZ Series Zener Diodes in MicroSMF (DO-219AC) Package Extremely Tight Tolerance of ± 2.5 %
64	BZD Series Zener Diodes SMF (DO-219AB) Package With Surge Current Specification

MOSFETS

65	Automotive AEC-Q101 Qualified Optimized for Low Conduction and Low Switching Losses
66	Low Voltage 25 V and 30 V Industry's Lowest $R_{DS(on)}$ in Advanced Space Saving Packages
67	Medium Voltage 40 V to 250 V Industry's Lowest $R_{DS(on)}$, Q_{oss} , Figure of Merit (FOM)
68	P-Channel Gen III and IV TrenchFET® Industry Leader in $R_{DS(on)}$ With Packages That Minimize Power Loss and Voltage Drop

69	PowerPAIR® Integrated Dual MOSFET Power Stage in Compact Packages for Increased Power Density
70	TrenchFET® and E-Series Wide Range of Advanced Packages

OPTOELECTRONICS

71	Fully Integrated Short and Long Range Proximity Sensors Include IR Emitter Photodiode Signal Processing and Programmability via I²C
72	VCNL4035X01 Gesture Sensor Enables any System to Respond to a Swipe Left, Swipe Right, or in and out Gesture
73	Single, Dual, Tri and Quad Channel Transmissive Sensors For Incremental and Absolute Encoding
74	Minimold IR Receivers Offer Improved off Angle Transmit Distance and RF Noise Immunity in a Through-Hole or Surface-Mount Package
75	TVCast SMD IR Receivers Lowest Profile (1.6 mm) Receiver on the Market for Super Thin TVs and Tight Spaces
76	VOR Series Solid-State Relays Low Voltages of 400 V and Load Currents Up to 140 mA, Ideal for Replacing Mechanical Relays
77	Large PIN Photodiodes 7.5 mm x 7.5 mm Radiant Active Area

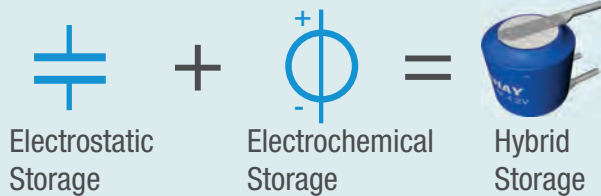
POWER ICs

78	SiC46x and SiC47x microBUCK® 4.5 V to 60 V Buck Regulators Deliver Up to 200 W Output Power
79	SiC43x microBUCK® Buck Regulator Family Enables High Power Density and Efficiency
80	Analog Switches and Multiplexers Enhanced Series for Precision Applications Designs

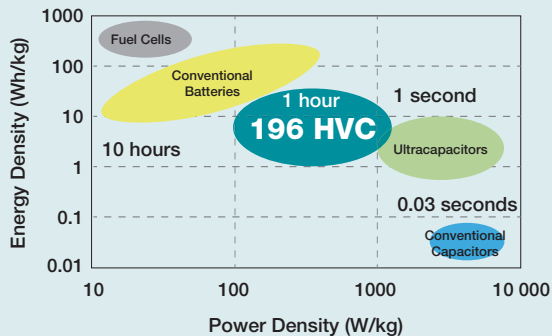


196 HVC ENYCAP™ HYBRID ENERGY STORAGE CAPACITORS

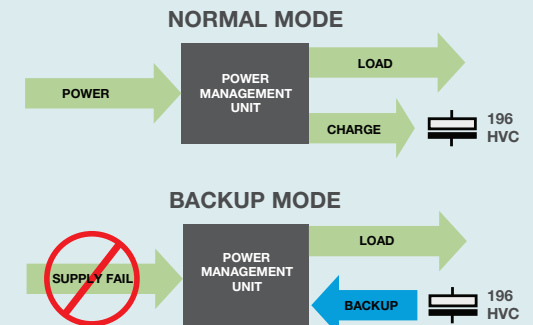
IN A NUTSHELL



THE 196 HVC ENYCAP "SWEET SPOT"



196 HVC ENYCAP POWER SOURCE



STACKABLE

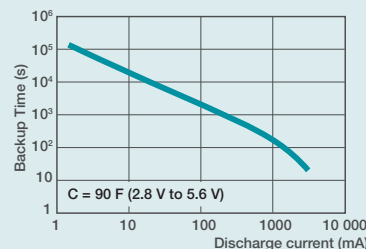


Higher Energy Density by Volume



460 Ws OF STORED ENERGY (4 CELLS)

Example
1 A for 200 s



196 HVC ENYCAP vs. a Battery

- More charge and discharge cycles: over 100 000
- No memory effect
- Longer lifetime

196 HVC ENYCAP vs. a Traditional Supercapacitor

- Lower self - discharge
- More than three times the energy density
- No cell balancing

FOUR CAPACITANCE OPTIONS

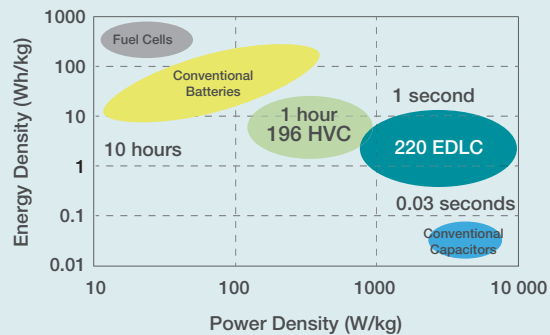


Not just a capacitor, it's the 196 HVC ENYCAP hybrid energy storage capacitor!



220 EDLC ENERGY STORAGE CAPACITORS

IN A NUTSHELL



PRODUCT VERSIONS

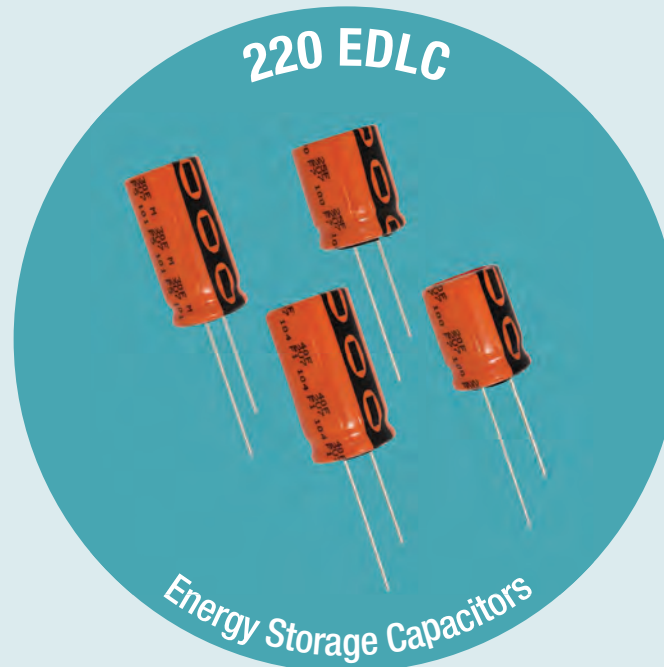
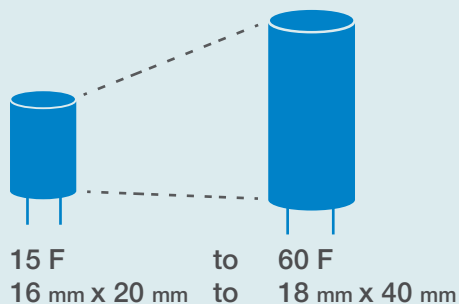
ENERGY

POWER

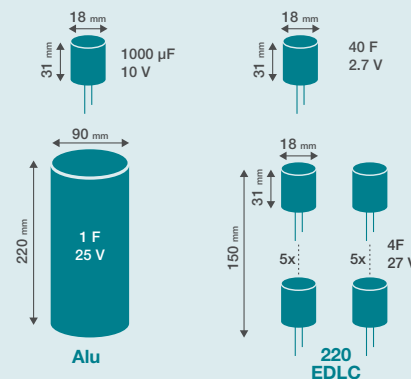
Low leakage current More capacity per volume

$$\text{Joule} = \text{Ws}$$

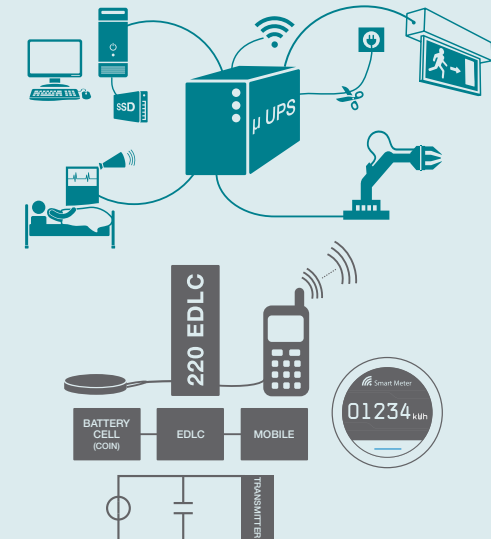
MULTIPLE CAPACITANCE VALUES



COMPARISON OF ALU VS. 220 EDLC



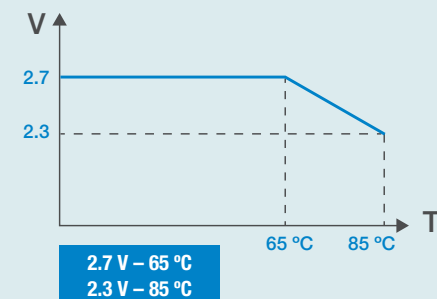
POWER BACK-UP APPLICATIONS



220 EDLC VS. BATTERY CELL

- Higher discharge current
- > 500 000 charge / discharge cycles
- Superfast charge and discharge
- Category temperature of -40 °C to +85 °C

VOLTAGE VS. TEMPERATURE



For Technical Questions: hybridstorage@vishay.com



HIGH TEMPERATURE ALUMINUM

SMD, RADIAL, AND AXIAL: +125 °C AND +150 °C



AEC-Q200
QUALIFIED
WITH PPAP
AVAILABLE

LEAD (Pb)-FREE
SOLDERING
ACCORDING TO
JEDEC®-J-STD-020



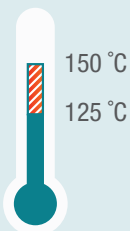
FEATURES

- Up to 6800 µF
- Up to 100 V
- Up to 2000 h / 150 °C

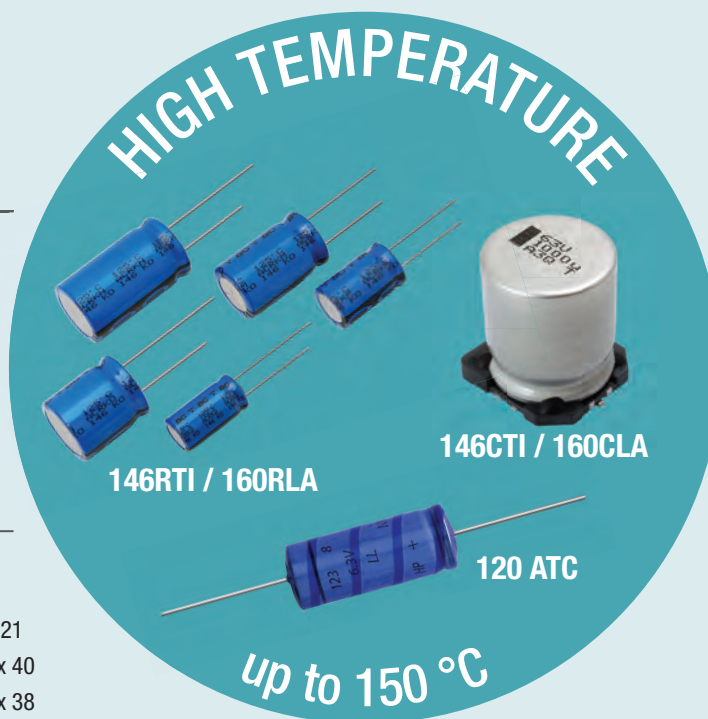
CASE SIZES (mm)

- SMD 8 x 10 up to 18 x 21
- Radial 10 x 12 up to 18 x 40
- Axial 10 x 30 up to 21 x 38

HAPPY HIGH TEMPERATURE CAPS



Aluminum Electrolytic
Capacitors for Harsh and
High Temperature
Operating Conditions



IN A NUTSHELL



APPLICATIONS

INDUSTRIAL



CONTROL UNITS



MACHINERY



AUTOMATION



MOTOR DRIVES



WELDING

AUTOMOTIVE



UNDER THE HOOD



CHASSIS



POWER TRAIN



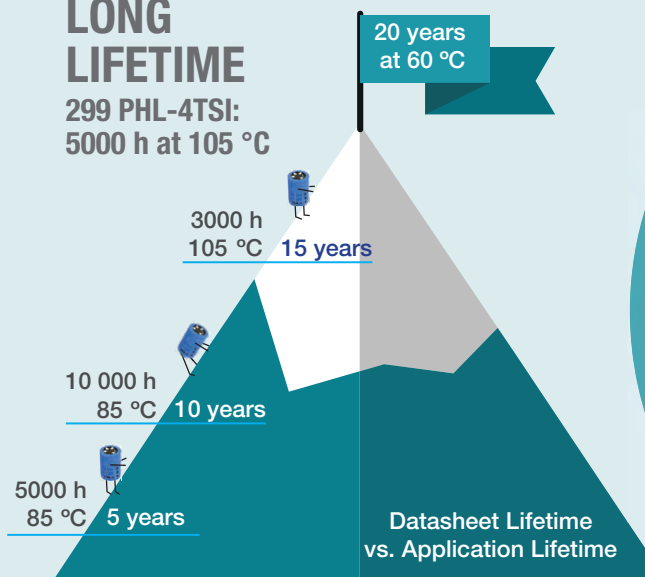
SNAP-IN ALUMINUM CAPACITORS

4-TERMINAL SNAP-IN DC-LINK SOLUTION

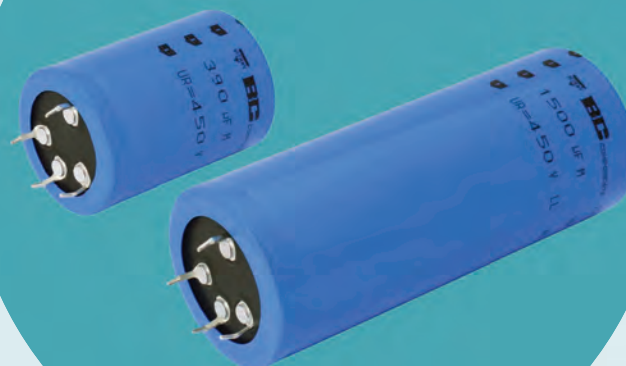
IN A NUTSHELL

LONG LIFETIME

299 PHL-4TSI:
5000 h at 105 °C

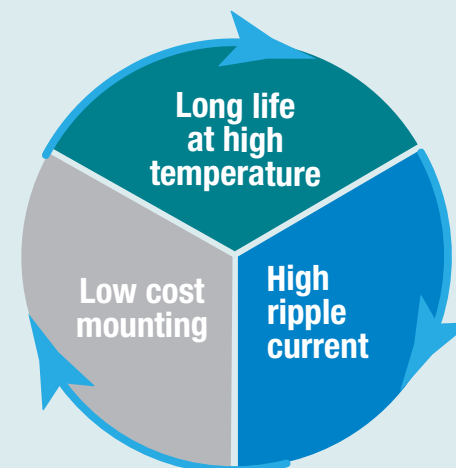


SNAP-IN SOLUTION

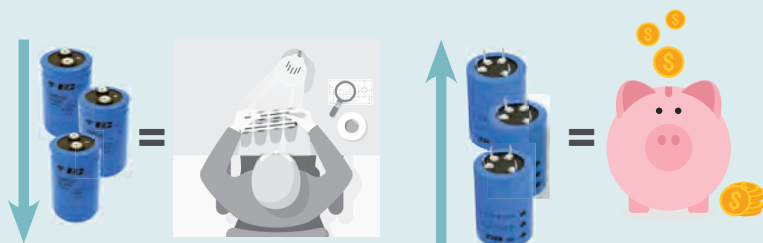


299 PHL-4TSI

KEYED
POLARITY
= ONE-WAY
MOUNTING



EFFICIENT ASSEMBLY, SOLDER ON HIGH CURRENT PCB



Less Manual Work Saves Time and Costs



Power
Electronics

SIZES BETWEEN SI AND ST

2-Pin SI (mm)	299 PHL-4TSI (mm)	ST (mm)
22 x 25	35 x 60	35 x 80
35 x 50	45 x 100	90 x 220

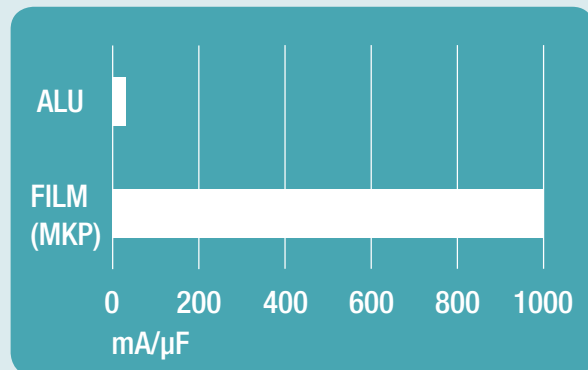


DC-LINK FILM CAPACITORS

LOW ESR, HIGH RIPPLE CURRENT CAPABILITIES

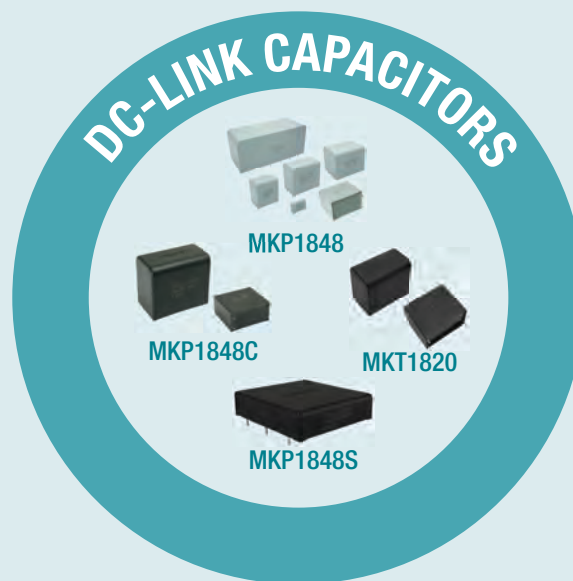
IN A
NUTSHELL

FILM CAPACITOR RIPPLE CURRENT
CAPABILITY VS. ALUMINUM ELECTROLITICS



ADVANTAGES OF DC-LINK FILM CAPACITORS OVER ALUMINUM ELECTROLYTIC

- High voltage capability: no series connection; no balancing resistors
- Self-healing technology
- Lifetime over 100 000 hours
- No dry out → stable parameters until the end of life
- Stable electrical parameters across temperature range

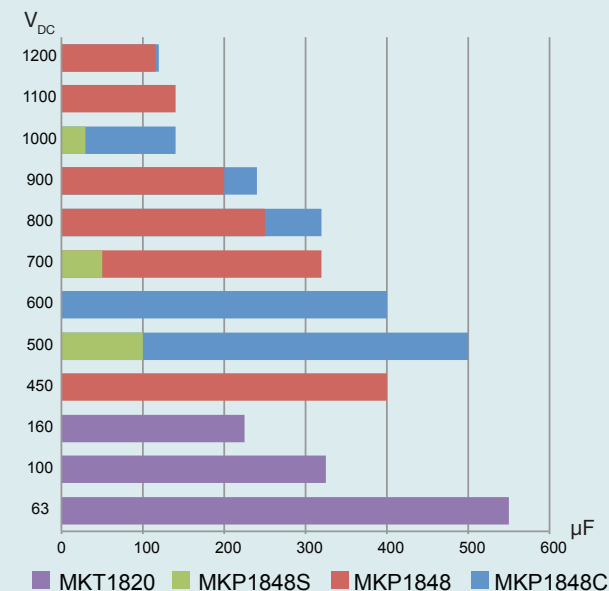


APPLICATIONS



- On-Board Chargers
- 48 V Board Net
- Forklifts
- Renewable Energy

DC-LINK FILM CAPACITORS
VOLTAGE VS. CAPACITANCE RANGE



MKP1848	MKP1848C	MKP1848S	MKT1820
Automotive Grade DC-Link Film Capacitor (AEC-Q200 Compliant)	High Density DC-Link Film Capacitor Up to 1 μF/cm ³	Low Profile DC-Link With Building Heights of 12 mm, 15 mm, 18 mm, and 24 mm	Low Voltage and High Temperature (Up to 150 °C) DC-Link for 48 V Board Net



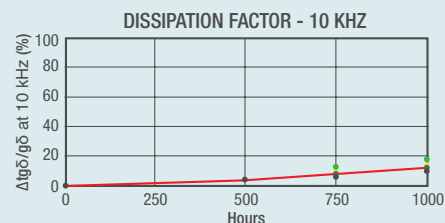
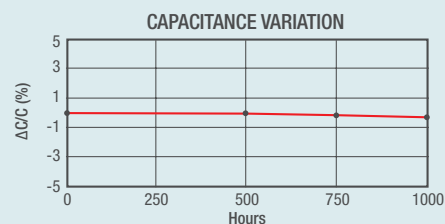
THB AC FILTERING

ROBUST DESIGN FOR HIGH HUMIDITY ENVIRONMENTS



IN A NUTSHELL

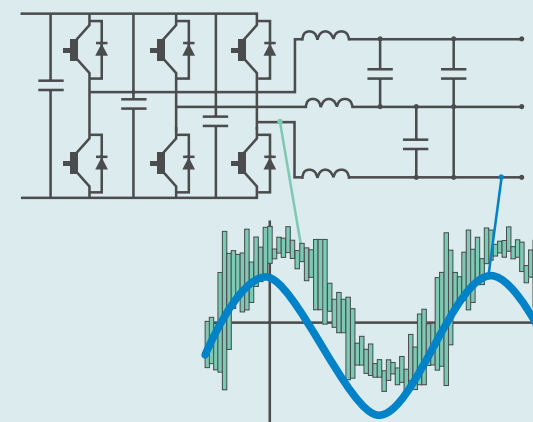
TYPICAL PERFORMANCE AT 85 °C / 85 %
RELATIVE HUMIDITY CONDITIONS FOR
1000 HOURS AT U_{NAC}



UL810-COMPLIANT
SEGMENTED FILM



HIGH PERFORMANCE FREQUENCY FILTER:
HARMONICS + SWITCHING NOISE



BROAD CAPACITANCE RANGE

PITCH (mm)		C (μF)																CONSTRUCTION
		1	2	3	4	5	6	7	8	10	12	15	20	22	25	30	35	
250 V _{AC}	27.5																	Mono
	37.5																	
	52.5																	
310 V _{AC}	27.5																	Mono
	37.5																	
	52.5																	
350 V _{AC}	27.5																	Series
	37.5																	
	52.5																	
480 V _{AC}	27.5																	Series
	37.5																	
	52.5																	

APPLICATIONS

- Outdoor applications
– Inverters and converters
- High power supplies and large drives
- UPS
- Renewable energy
- Welding equipment
- AC harmonic filters





LVAC POWER CAPACITORS

LOW LOSS MKP TECHNOLOGY

IN A NUTSHELL

FLEXIBLE DESIGN OPTIONS

FOOTPRINT

HEIGHT



64 mm / 84 mm /
116 mm / 136 mm



82 mm to 340 mm



RoHS
COMPLIANT



PhMKP SERIES



Vishay ESTA Capacitors

TEMPERATURE CLASS

- 40 °C / D



LIFE EXPECTANCY

- > 130 000 h
- 100 FIT



SAFETY FEATURES

- Internal tear-off fuses
- Self-healing film
- Discharge resistor
< 50 V/1 minute



FILLING AGENT

- ESTAdry gas
- ESTAprop oil



HIGHLIGHT



ESTAspring

maintenance-free,
vibration-proof, and reduces
assembly times up to 60 %



[ESTAspring
brochures](#)

STANDARDS

IEC 60831

ESTAspring CONNECTION

Lever-operated spring connection

Cable cross section: 2.5 mm² up to 25 mm²

Max. terminal current = 90 A_{RMS}

Protection level: IP20

Voltage AC RMS

230 V

1000 V

Output

2.0 kvar

37.1 kvar

3-Phase Delta
Capacitance

11.5 µF

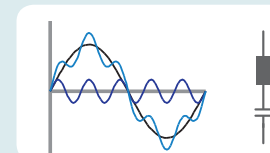
335 µF

Customizable

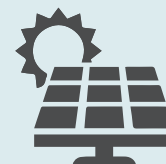
APPLICATIONS



WIND POWER
PLANTS



HARMONIC FILTERS

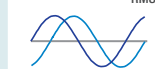


SOLAR PANELS
AND INVERTERS



THERMAL POWER
STATIONS

≤ 1000 VAC_{RMS}



POWER FACTOR
CORRECTION

For Technical Questions: esta@vishay.com



LVAC POWER CAPACITORS

LOW LOSS MKP TECHNOLOGY

IN A NUTSHELL

HIGHLIGHT

Triangular design provides lowest height for 50 kVAr; custom heights for higher outputs on request

HEIGHT



210 mm

Maintenance-free, vibration-proof bolt-terminal by counternuts, 20 Nm



STANDARDS

IEC 60831

CONNECTION

M10 threaded bolt, 20 Nm

Max. terminal current = 110 A_{RMS}

Protection level: IP00, terminal covers upon request

Voltage AC RMS

230 V

1000 V

Output

30 kVAr

56.2 kVAr

3-Phase Delta Capacitance

115.5 μ F

331.6 μ F

Also Customizable for Outdoor Applications



RoHS COMPLIANT



TEMPERATURE CLASS

- 40 °C / D



LIFE EXPECTANCY

- > 130 000 h
- 100 FIT



SAFETY FEATURES

- Internal tear-off fuses
- Self-healing film
- Discharge resistor
≤ 50 V/1 minute (indoor)
≤ 75 V/3 minutes (outdoor)



FILLING AGENT

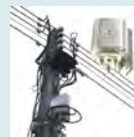
- ESTAdry solid resin



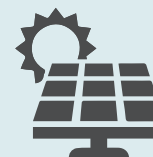
APPLICATIONS



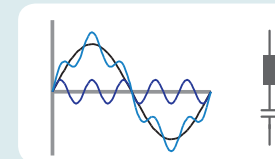
WIND POWER PLANTS



POLE-MOUNTED OUTDOOR



SOLAR PANELS AND INVERTERS

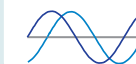


HARMONIC FILTERS



THERMAL POWER STATIONS

≤ 1000 VAC_{RMS}



POWER FACTOR CORRECTION

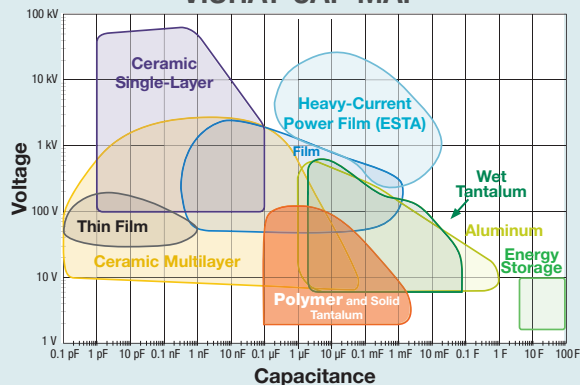


POWER ELECTRONIC CAPACITORS

HIGH CURRENT, LOW INDUCTANCE

IN A NUTSHELL

VISHAY CAP MAP



STANDARDS

IEC 61071, IEC 61881-1

RoHS

COMPLIANT

VOLTAGE DC

• 900 V to 2700 V

CAPACITANCE

• 40 μ F to 2235 μ F

LIFE EXPECTANCY

• > 100 000 h
• < 100 FIT

FILLING AGENT

• ESTAdry resin
• UL 94 V-0

FEATURES

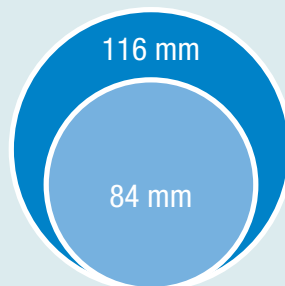
- High RMS current rating
- High impulse current rating
- High reliability and lifetime expectation
- Resistance to heavy-duty shock vibration
- Non-polar, low loss dielectric
- Temperature class: -40 °C / 70 °C

HDMKP SERIES



Vishay ESTA Capacitors

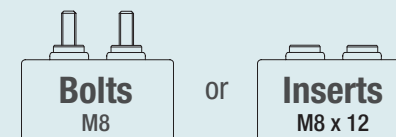
FOOTPRINT



HEIGHT



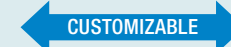
CONNECTION



SAFETY

- Self-healing film

OPTIONS



APPLICATIONS



WIND TURBINE



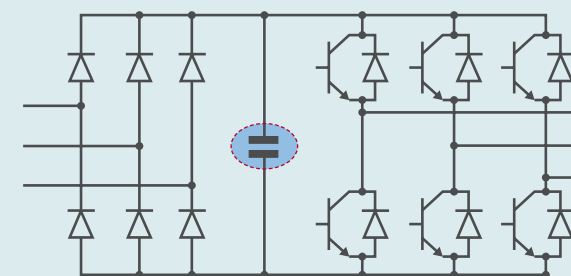
TRANSPORTATION



INDUSTRIAL

- DC link and DC filters for industrial and traction converters
- DC link for low power drives
- DC link for wind turbine converters
- Impulse discharge capacitors for magnetizing and welding
- Replacement of aluminum electrolytic capacitors

DC LINK



For Technical Questions: esta@vishay.com



RFI CAPACITOR SOLUTIONS

FILM AND CERAMIC

IN A NUTSHELL

CLASS X

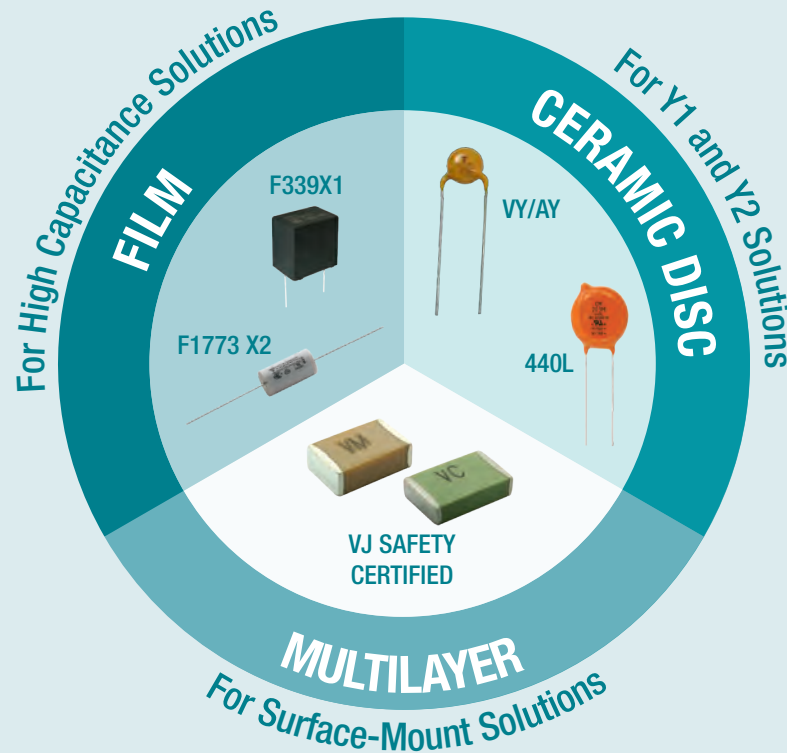
Differential Mode Filtering Across the Line

Sub Class	Peak Impulse Voltage	Typical Application
X1	4.0 kV	High Pulse
X2	2.5 kV	General Purpose

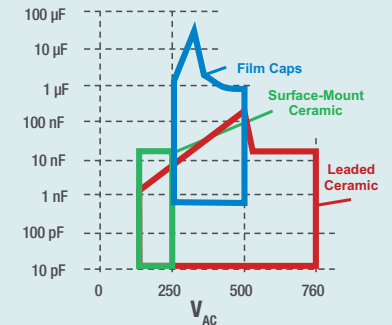
CLASS Y

Common Mode Filtering Line to Ground

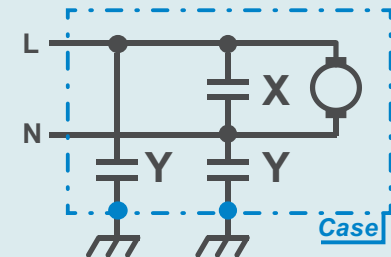
Sub Class	Peak Impulse Voltage	Typical Application
Y1	8.0 kV	High Pulse
Y2	5.0 kV	General Purpose



SAFETY CAPACITOR MAP



TYPICAL CIRCUIT



Technology	Rating	Series	Capacitance	Certificates	Special Features
Ceramic Disc	X1 / Y1	VY1, VY1C, WKP, 440L	10 pF to 20 nF	IEC, UL, CSA, and CQC	Industry-first 20 nF, 85 °C / 85 % RH 1000 h available
	X1 / Y2	VY2, AY2, WYO	10 pF to 12 nF	IEC, UL, CSA, and CQC	AEC-Q200 available
MLCC	X1 / Y2	VJ Safety Certified COG (NP0)	10 pF to 1000 pF	IEC, cCSA	1 nF in X1/Y2 with COG (NP0) Meets IEC 60384-14 min. 4 mm creepage
	X2		10 pF to 470 pF	IEC, cCSA	Meets IEC 60384-14 min. 4 mm creepage
	X1 / Y2	VJ Safety Certified X7R	100 pF to 4700 pF	IEC, cCSA	Meets IEC 60384-14 min. 4 mm creepage
	X2		100 pF to 12000 pF	IEC, cCSA	Meets IEC 60384-14 min. 4 mm creepage
Film	X1	F339X1 480 VAC; 330 VAC	0.001 μF to 2.2 μF	IEC, UL, CSA, and CQC	THB grade available
	X2	F1772(S), F339M, MKP339, F1773	0.001 μF to 40 μF	IEC, UL, CSA, and CQC	AEC-Q200 available, THB grade; axials on demand
	Y2	MKP3386Y2	0.001 μF to 0.47 μF	IEC, UL, and CSA	AEC-Q200 available

For Technical Questions: cdc@vishay.com or mlcc@vishay.com

For a Full Overview of
RFI Capacitors, Please Visit
www.vishay.com/doc?48140



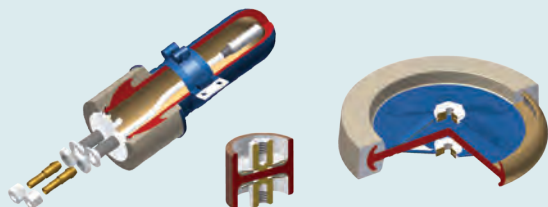
CERAMIC RF POWER CAPACITORS

DETERMINED BY VOLTAGE, CURRENT, AND POWER

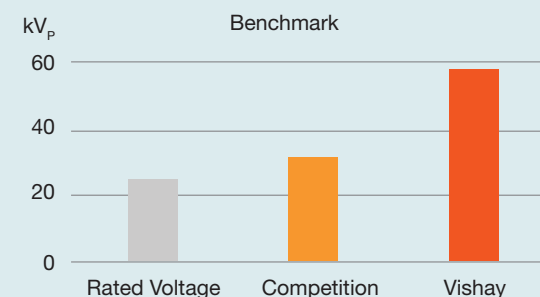
IN A NUTSHELL



CUSTOMIZED PRODUCTS AVAILABLE



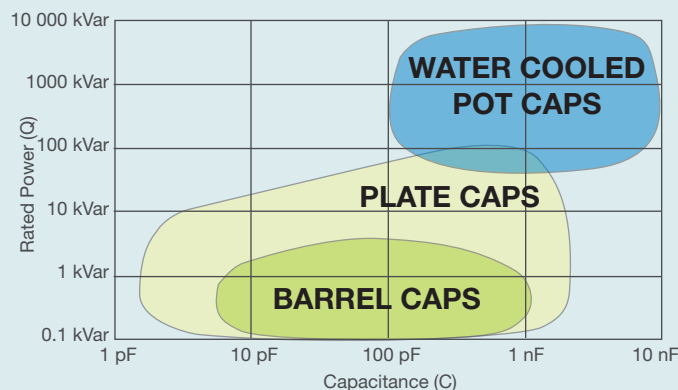
BREAKDOWN VOLTAGE



APPLICATIONS



RF POWER MAP



HIGHEST PROVEN PERFORMANCE AND QUALITY IN THE MARKET

Plate Caps	Barrel Caps	Water Cooled Pot Caps
<ul style="list-style-type: none"> Low losses High reliability Wide range of capacitance values 	<ul style="list-style-type: none"> Small size Geometry minimizes inductance, optimizes voltage strength, and maximizes heat radiation 	<ul style="list-style-type: none"> High voltage, current, and power rating Water cooling and rugged mechanical construction for highest reliability

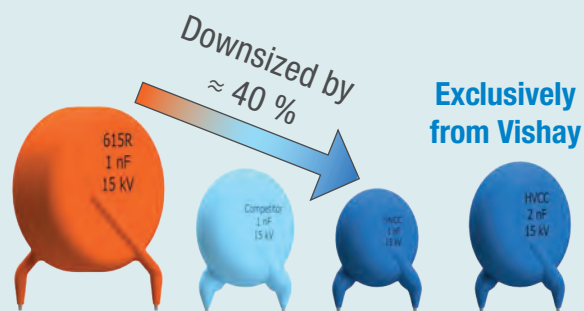
For Technical Questions: powcap@vishay.com



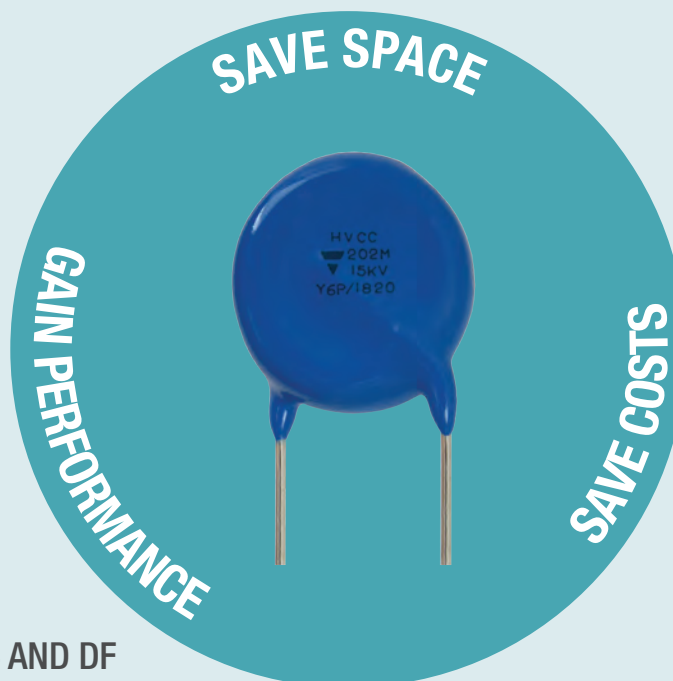
HIGH VOLTAGE CERAMIC CAPACITOR

RADIAL-LEADED SINGLE DISC

IN A NUTSHELL



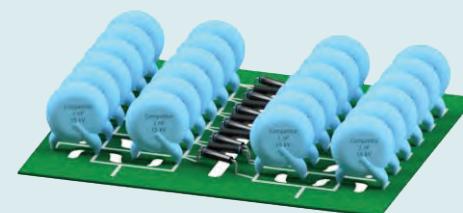
615R	Competitor	HVCC	HVCC
1 nF	1 nF	1 nF	2 nF
15 kV	15 kV	15 kV	15 kV



2 nF HVCC Comparison

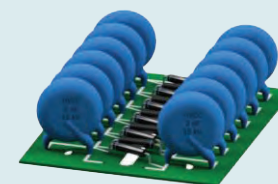
COMPETITOR SOLUTION

State of the art 12 stage multiplier, 15 kV,
2 x 1 nF in parallel



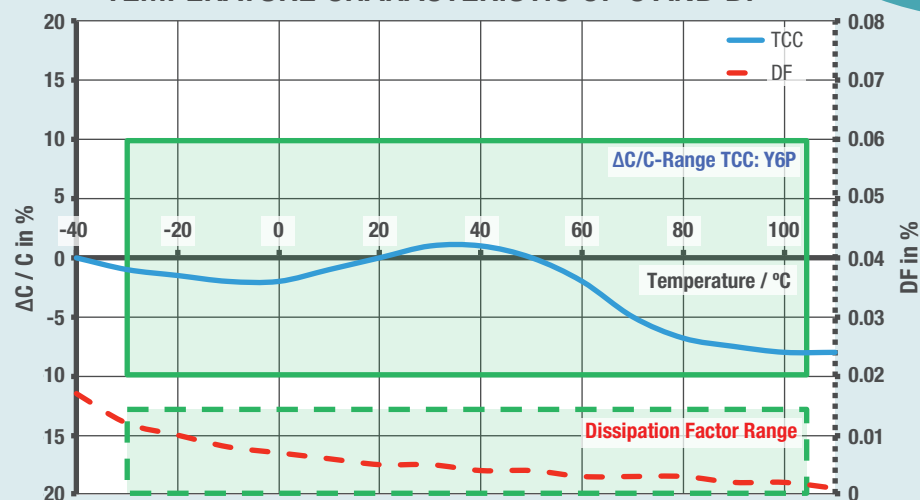
VISHAY REPLACEMENT

Unique 2 nF cap enables space saving
12 stage multiplier, 15 kV, 1 x 2 nF



Downsized by up to
half of components

TEMPERATURE CHARACTERISTIC OF C AND DF



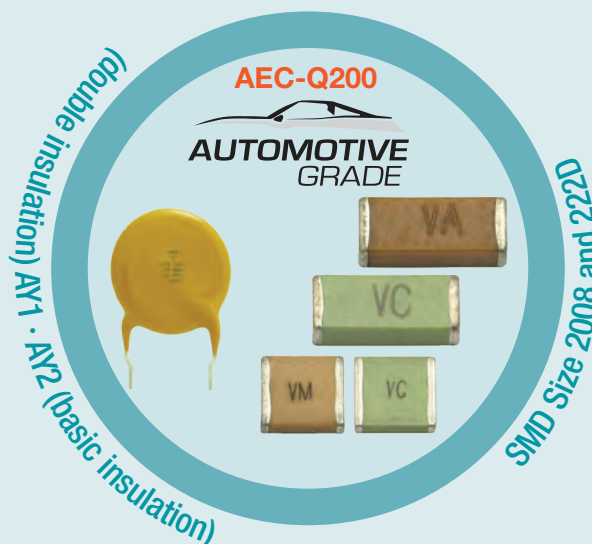
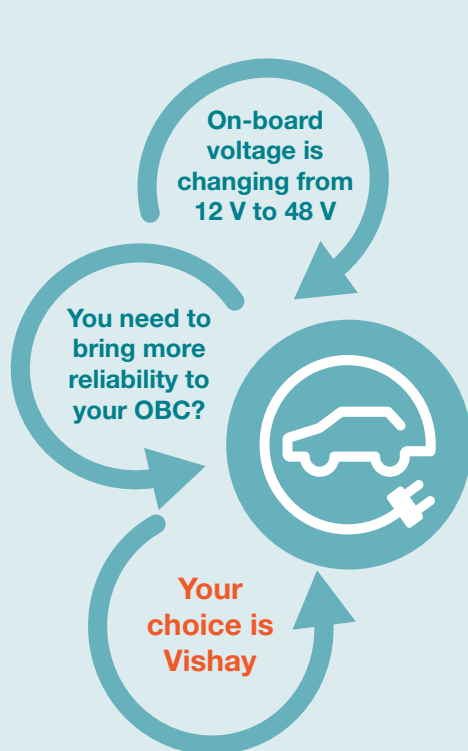
HVCC Series	SPEC
U_{rated}	10, 15 kV _{DC}
TCC / Operating Temperature	Y6P / $\Delta C/C_0$ less than $\pm 10\%$ from $-30\text{ }^{\circ}\text{C}$ to $+105\text{ }^{\circ}\text{C}$
Capacitance Range	up to 2.0 nF
Life Performance	$1.25 \times U_{rated}$ at $105\text{ }^{\circ}\text{C}$ at 1000 h



AUTOMOTIVE GRADE CERAMIC SAFETY CAPACITORS LEADED CERAMIC SINGLE DISC AND SMD MLCCs

IN A NUTSHELL

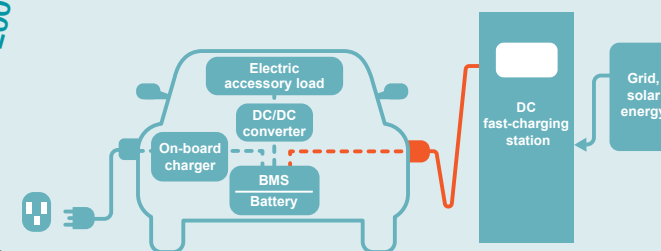
Technology	Series	Rating	Rated Voltage	Capacitance	Peak Impulse Voltage	Features
Ceramic Single Disc	AY1	X1 / Y1	X1: 760 V _{AC} Y1: 500 V _{AC} 1500 V _{DC}	470 pF to 4.7 nF	X1: 4 kV Y1: 10 kV	10 kV peak impulse voltage
Ceramic Single Disc	AY2	X1 / Y2	X1: 440 V _{AC} Y2: 300 V _{AC} 1000 V _{DC}	10 pF to 10 nF	X1: 4 kV Y2: 5 kV	Passes 3000 temperature cycles 6.8 nF and 10 nF available
SMD MLCC COG (NPO) SMD MLCC X7R	VJ...A...X1A VJ...Y...X1A	X1 / Y2	250 V _{AC}	COG(NPO): 10 pF to 1 nF X7R : 100 pF to 4.7 nF	X1 / Y2: 5 kV	Small body size, low profile, min. 4 mm creepage, voltage-proof test min. 1500 V _{AC} , Class I COG (NPO), stable electric up to 1 nF, SMD reflow assembly
SMD MLCC COG (NPO) SMD MLCC X7R	VJ...A...X2A VJ...Y...X2A	X2	250 V _{AC}	COG(NPO): 10 pF to 390 pF X7R : 100 pF to 12 nF	X2: 2.5 kV	Small body size, low profile, voltage-proof test min. 1075 V _{DC} , min. 4 mm creepage, SMD reflow assembly



Outstanding Qualification Test	IEC 60384-14.4 (Industry standard)	AEC-Q200 (Automotive standard)
Temperature cycles	-40 °C / +125 °C 5 cycles	-55 °C / +125 °C 1000 cycles
Humidity (biased)	500 h at 40 °C 90 to 95 % r.h., U _{rated}	1000 h at 85 °C 85 % r.h., U _{rated}

APPLICATIONS

- On-board Charger
- External Charging Station
- Battery Management
- DC/DC Converter



AC charging

- Every vehicle has an on-board charger
- Limited power, slow charging

DC charging

- Infrastructure investment if shared among hundreds of users
- Capable of integration with renewable resources



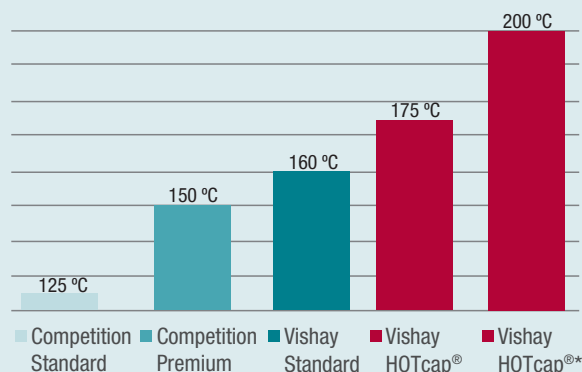
HIGH OPERATING TEMPERATURE RADIAL-LEADED AUTOMOTIVE MLCCs

IN A NUTSHELL



AEC-Q200 Qualified
With PPAP Available

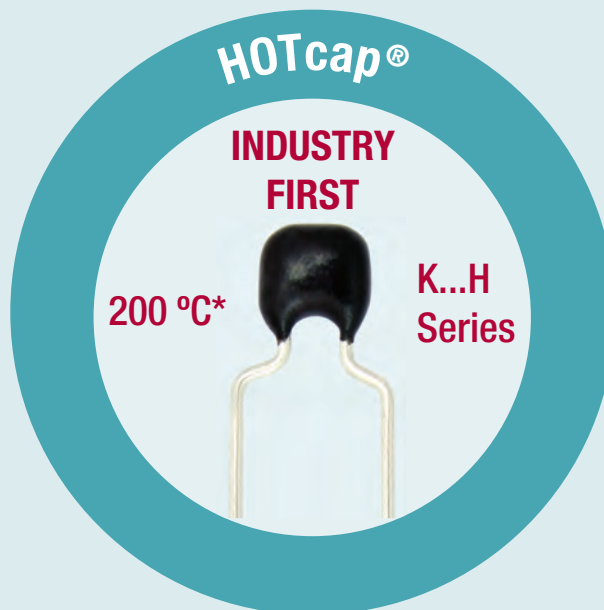
OPERATING TEMPERATURE IN AUTOMOTIVE



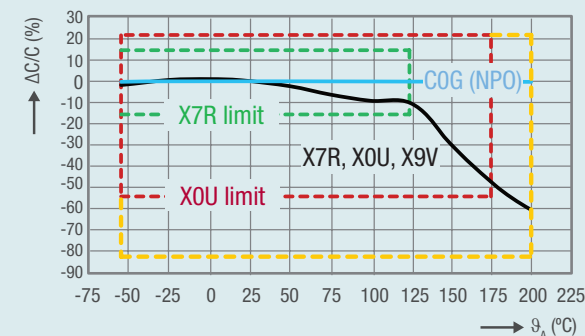
Not an ordinary **CAPACITOR**,
it's built for the **MOST EXTREME**
automotive operating conditions

KEY APPLICATIONS

- ✓ Engine control
- ✓ Engine sensor protection
- ✓ Exhaust system



CAPACITANCE CHANGE VS. TEMPERATURE



Dielectric	COG			X0U		
Voltage V_{DC}	50	100	200	50	100	200
Min. Cap.	100 pF	100 pF	100 pF	47 nF	47 nF	82 nF
Max. Cap.	12 nF	12 nF	8.2 nF	1 μ F	470 nF	470 nF



SMD	Leaded MLCC
<ul style="list-style-type: none"> PCB bending and vibration may cause mechanical stress and capacitor cracks 	<ul style="list-style-type: none"> More robust to thermo-mechanical stress and vibration Impact on the MLCC is reduced as the lead wires absorb the bending stress The capacitor can be welded or soldered directly to a lead frame and overmolded with plastic
<p>BOARD DEFLECTION CRACKS</p> <p>Leaded Product</p>	<p>Chip Component</p>

* 200 °C for max. 500 hours and 175 °C unlimited time

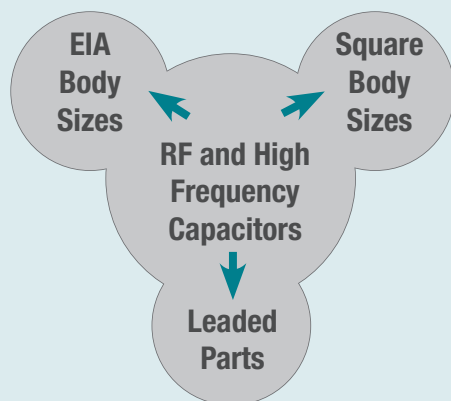
For Technical Questions: cmll@vishay.com



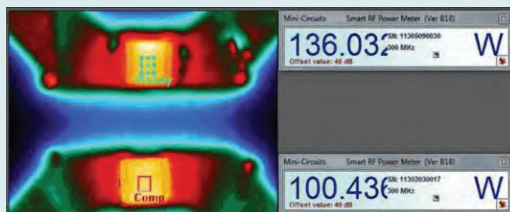
MULTILAYER CERAMIC CHIP

RF AND HIGH FREQUENCY CAPACITORS

IN A NUTSHELL



VISHAY QUAD CAPACITORS
HANDLE 35 % MORE POWER

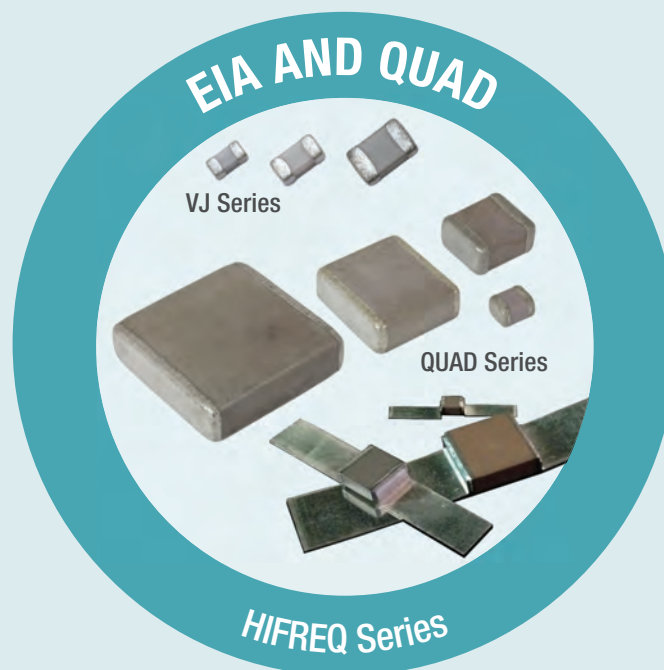


HIGH TEMPERATURE OPERATION



TERMINATION OPTIONS

- Lead (Pb)-free RoHS-compliant: "X"
- Tin / lead (min. 4 % Pb): "L"
- Non-magnetic copper: "C"



FOOTPRINT

Shown actual size (when viewed or printed at 100 %)

VJ HIFREQ

QUAD HIFREQ

0402

0603

0805

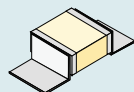
0505

1111

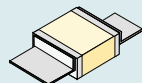
2525

3838

LEADED CONFIGURATIONS



Microstrip



Axial Ribbon



Radial Ribbon

VJ HIFREQ SERIES

Voltage	Capacitance Range (pF)		
	0402	0603	0805
25	0.1 to 82	0.1 to 470	0.1 to 1500
50	0.1 to 56	0.1 to 330	0.1 to 1000
100	0.1 to 27	0.1 to 150	0.1 to 680
200	0.1 to 27	0.1 to 100	0.1 to 390
250		0.1 to 100	0.1 to 330

Tolerance as tight as ± 0.05 pF for capacitance values ≤ 10 pF
Tolerance as tight as ± 1 % for capacitance values > 10 pF

QUAD HIFREQ SERIES

Voltage	Capacitance Range (pF)			
	0505	1111	2525	3838
200	0.1 to 100	0.2 to 1000	1 to 2700	1 to 5100
250	0.1 to 56			
300				
500		0.2 to 470	1 to 2000	1 to 2000
630				
800				
1000		0.2 to 180	1 to 1200	1 to 750
1500		0.2 to 110		
2000			1 to 470	1 to 390
2500			1 to 270	
3000			1 to 100	
3600				1 to 180
5000				1 to 100
7200				

Tol. as tight as ± 0.05 pF for cap. values ≤ 10 pF (0505 / 1111)
Tol. as tight as ± 0.1 pF for cap. values ≤ 10 pF (2525 / 3838)
Tol. as tight as ± 1 % for capacitance values > 10 pF



MAP POLYMER CAPACITORS

HIGH ENERGY DENSITY CAPACITORS

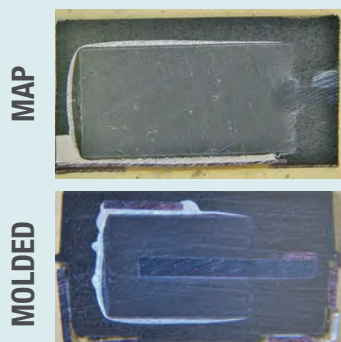
IN A NUTSHELL

DERATING

		Standard Tantalum	Polymer
Example	Specified Derating	50 %	20 %
	Rated Voltage	10 V	6.3 V
	Design Voltage	5 V	5 V

VISHAY MAP MEANS MORE CAP

Large anode size



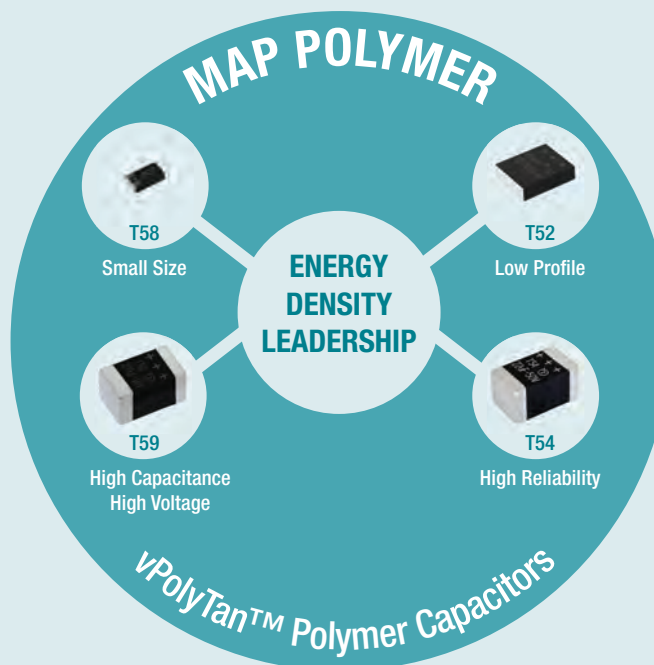
Examples:

T58 – 330 μ F at 6.3 V, BB case size

T58 – 47 μ F at 6.3 V, M0 case size

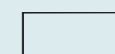
T52 – 330 μ F at 16 V, M1 case size

T59 – 470 μ F at 16 V, EE case size



TERMINATIONS

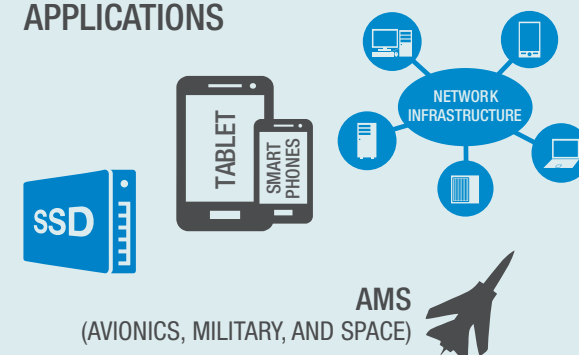
L-Shaped
(T58, T52)



Wraparound
(T59, T54)



APPLICATIONS



VISHAY CAPABILITY

T58								T52		T59	T54
BB	B2	B0	A0	W0	W9	M0	MM	M1	E5	EE	EE
0.138 (3.5) 0.11 (2.8)	0.138 (3.5) 0.11 (2.8)	0.138 (3.5) 0.11 (2.8)	0.126 (3.2) 0.063 (1.6)	0.079 (2.0) 0.049 (1.25)	0.079 (2.0) 0.049 (1.25)	0.063 (1.6) 0.033 (0.85)	0.063 (1.6) 0.033 (0.85)	0.287 (7.3) 0.236 (6.0)	0.287 (7.3) 0.169 (4.3)	0.287 (7.3) 0.169 (4.3)	0.287 (7.3) 0.169 (4.3)
0.079 (2.0)	0.042 (1.2)	0.039 (1.0)	0.039 (1.0)	0.039 (1.0)	0.035 (0.9)	0.039 (1.0)	0.035 (0.9)	0.079 (2.0)	0.059 (1.5)	0.169 (4.3)	0.169 (4.3)

Shown at actual size (when viewed or printed at 100 %)

Profile in inches (millimeters)

For Technical Questions: polytech@vishay.com



POLYMER CAPACITORS

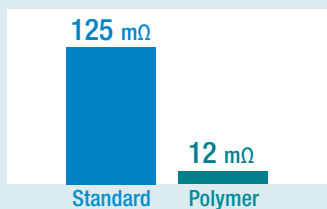
HIGH CAPACITANCE, LOW ESR CAPACITORS

IN A NUTSHELL

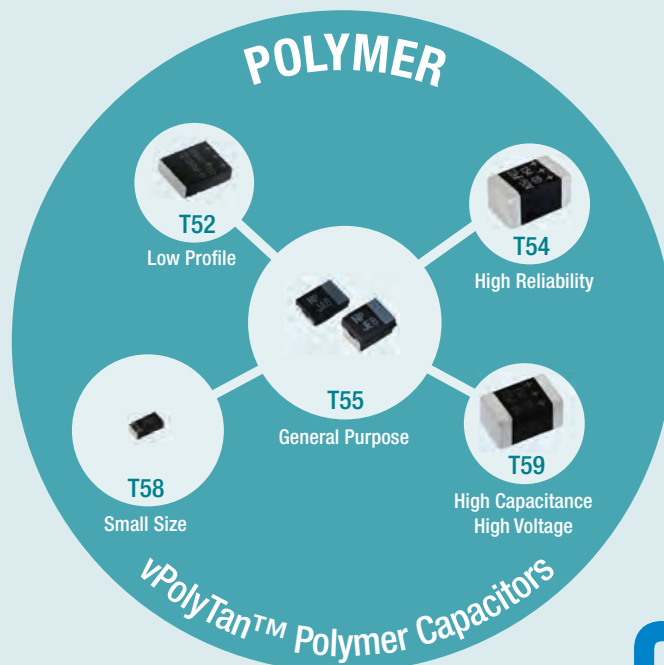
DERATING

		Example	
	Specified Derating	Rated Voltage	Design Voltage
Standard Tantalum	50 %	10 V	5 V
Polymer	20 %	6.3 V	5 V

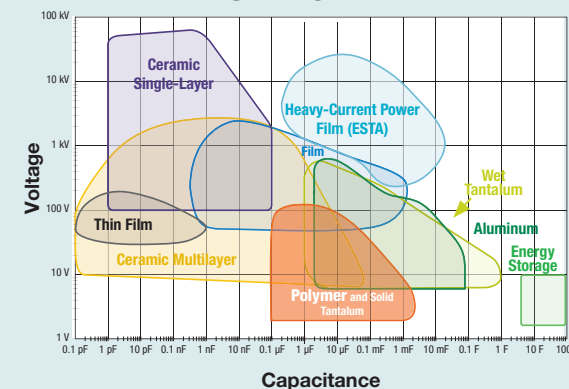
Ultra Low ESR (10x improvement)



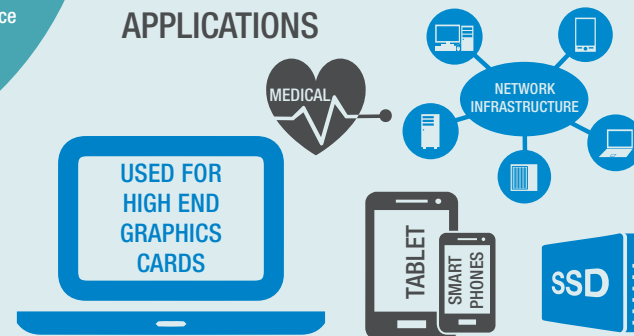
330 μF, 6.3 V, D CASE SIZE



VISHAY CAP MAP



APPLICATIONS



VISHAY CAPABILITY

M1	EE	E1	D	V	B	BB	B0	T	A	AA	A0	P	W0	W9	M0	MM	J
■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

FOOTPRINT + PROFILE

Shown at actual size (when viewed or printed at 100 %)



Polymer Capacitors Advantages Over MLCC	Polymer Capacitors Advantages Over Standard Tantalum	Polymer Capacitors Advantages Over Aluminum
<ul style="list-style-type: none"> No piezo noise effect No capacitance loss with DC bias More robust design (no cracking) Superior temperature stability 	<ul style="list-style-type: none"> Lower ESR Non-burn feature Better derating 	<ul style="list-style-type: none"> Superior stability Longer life Higher operating temperature range Better volumetric efficiency

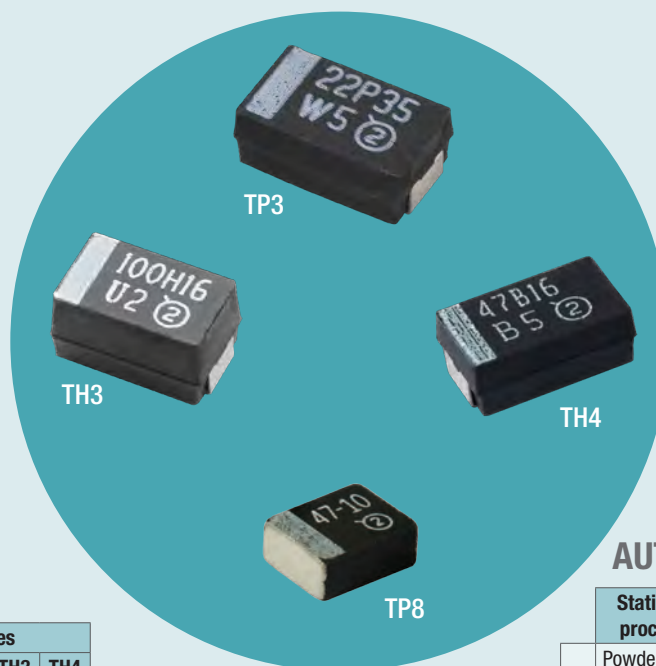


AUTOMOTIVE GRADE TANTALUM CAPACITORS

HIGH PERFORMANCE, HIGH TEMPERATURE, SMALL SIZES

IN A NUTSHELL

Solid Tantalum Surface-Mount Chip Capacitors, Molded Case		
Series	Feature	AUTOMOTIVE GRADE
TP3	High Performance High Reliability	✓
TH3	 150 °C	✓
TH4	 175 °C	✓
TP8	Leadframeless, High CV	✓



PERFORMANCE CHARACTERISTICS

www.vishay.com/docs/40215/typperfmoldedchipcaps.pdf

AUTOMOTIVE APPLICATIONS

		Series			
	Application	TP3	TP8	TH3	TH4
Power train	Gasoline direct injection			x	x
	Transmission	x		x	x
	Oil & water pump	x		x	x
	Oil quality sensor			x	x
Passive safety	Airbag			x	x
	Tire pressure monitoring sensor (TPMS)		x		
Active safety	Anti-lock braking system (ABS)			x	x
	Lane departure camera	x	x		
	Electric stability program (ESP)	x			
Passive safety	Key less entry		x		
	Smart airbag igniter	x		x	
Chassis	Electronic power steering (EPS)	x		x	
Body control	Electrical park break			x	x
	Heating, ventilation, air-con	x		x	x
	LED lighting	x	x	x	x
Battery management	Charging control	x			x
Infotainment & navigation	Display and controller LDO	x	x		
Surround view camera	FPGA power supply	x	x		
Electric vehicle	On-board charger		x		

QUALITY

- IATF 16949
- AEC-Q200
- TAQ:
 - LAT
 - Maverick lots
 - Error proofing
 - 6 Sigma
 - FMEA



AEC-Q200
PPAP available

AUTOMOTIVE GRADE FOR SUPERIOR QUALITY

	Station / process	Automotive Grade	Standard
Front End	Powder preparation	Use of single powder batch	Use of mixed powder batches
	Pressing / Sintering	Pellet lot from single powder batch	No requirement
	Formation	Visual inspection for coating dimensions: 5 pellet per bar x 3 bars per lot.	No requirement
	Cap test	Conductivity monitoring	No requirement
	Silver check	Visual inspection x3: 3 bars per rack (zero defect allowed)	Visual inspection, 4 bars per lot
Assembly	Assembly	Inspection of each 5 th LF (zero defect allowed)	Inspection of each 9 th LF (specified allowed failure rate)
		100 % VI after assembly	No requirement
		Special technician inspection and adjustment after each no weld detected	No requirement
	Electrical test	Redundant test	Single test (A / B / C cases); redundant test (D / E cases)
	Surge test	B, C, D, and E cases	D and E cases
	Labeling	Autolabeling attachment only	No requirement
	QC	Scan / scan verification of each reel LAT and Maverick lot inspection	First and last reel only No requirement



WET TANTALUM CAPACITORS

THE ULTIMATE RELIABILITY AND PERFORMANCE CHOICE FOR EXTREME APPLICATIONS

IN A NUTSHELL

KEY FACTORS

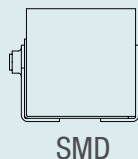
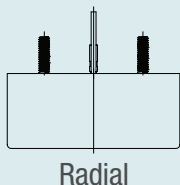
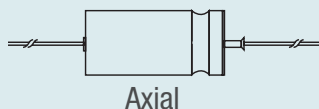


Capacitance
Performance
Energy
Temperature

QUALIFICATIONS

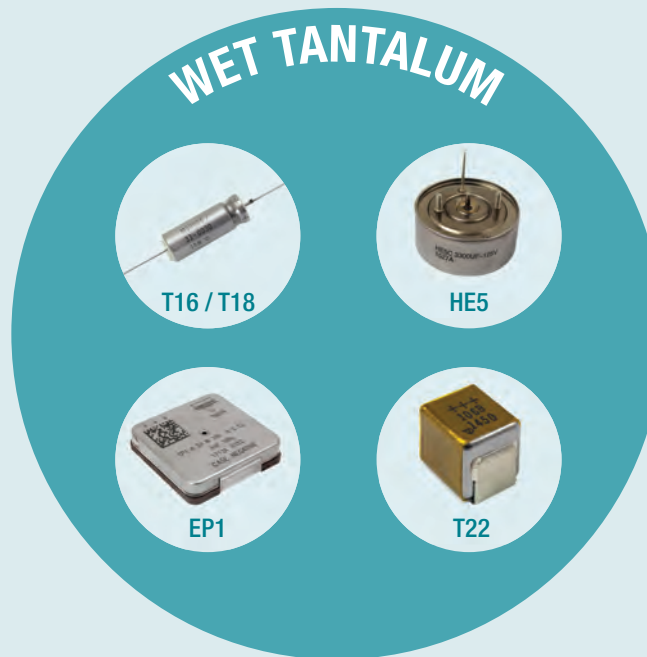
- M39006/09/21/22/25/30/31/33
- DLA 06013/06014/06015/06016
- DLA 04003/10004/10011/13017/15008/93026
- CECC 30202/001/002/004/005/801

LEAD CONFIGURATIONS

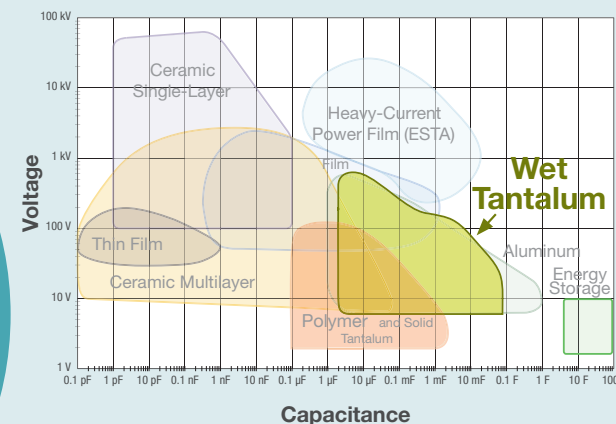


TERMINATION OPTIONS Tin / Lead

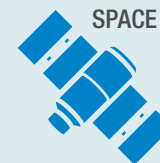
Lead (Pb)-free (100 % tin)
RoHS-compliant



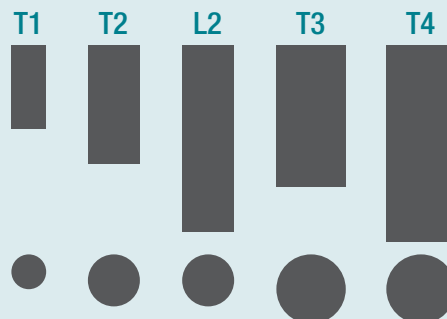
VISHAY CAP MAP



APPLICATIONS



VISHAY CAPABILITY



FOOTPRINT + PROFILE



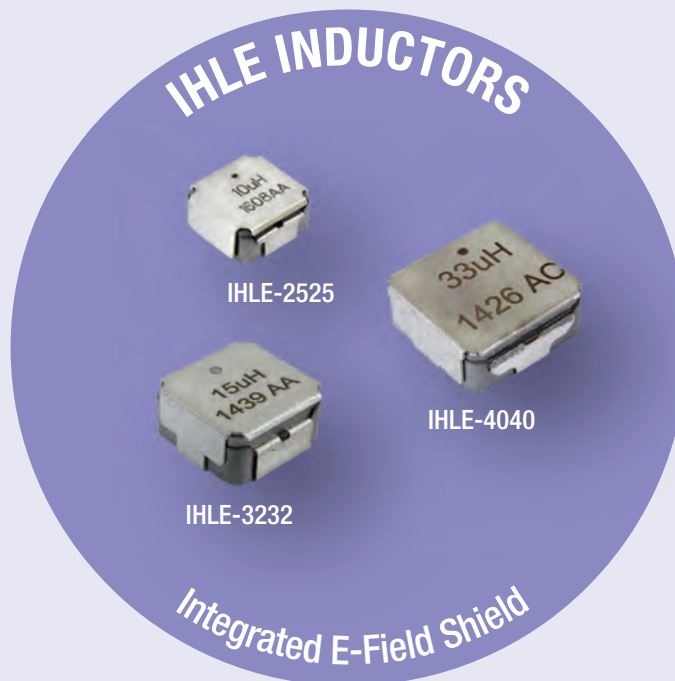
Shown at actual size (when viewed or printed at 100 %)



IHLE HIGH CURRENT INDUCTORS WITH INTEGRATED E-FIELD SHIELD

IN A NUTSHELL

Reduced noise

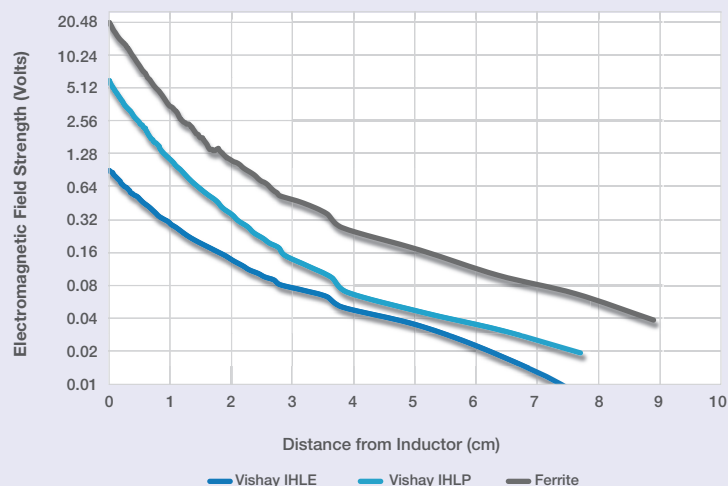


High temperature
operation to **+155 °C**



Compact size with
no additional
external **EMI**
shielding required

ELECTROMAGNETIC FIELD STRENGTH VS. DISTANCE FROM INDUCTOR



APPLICATIONS



DC/DC
INVERTERS



AUTOMOTIVE

FOOTPRINT AND PROFILE CAPABILITY

IHLE-2525



3.2 mm

IHLE-3232



4.3 mm

IHLE-4040



4.3 mm

Shown at actual size
(when viewed or printed at 100 %)

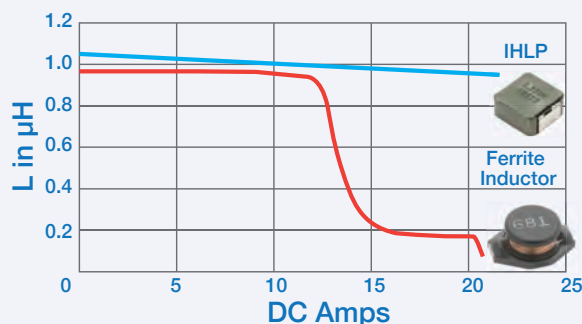


IHLP® POWER INDUCTORS

LOW PROFILE POWER INDUCTORS

IN A NUTSHELL

SATURATION – IHLP VS. FERRITE INDUCTOR



APPLICATIONS

DC/DC converters

- Power supplies for computers, notebooks, graphic cards, servers

Class “D” amplifiers

- LCD TVs and portable MP3 speakers

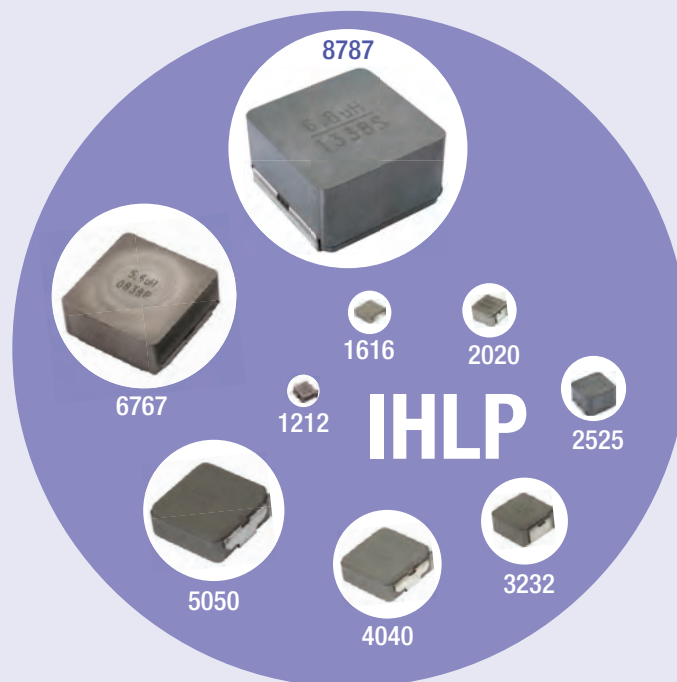
LED driver power

- Commercial LED lighting
- LCD display backlights

Automotive

- DC/DC converters
- Filters for noise suppression

All currently available IHLP footprints meet or exceed AEC-Q200 Grade 0 and Grade 1 requirements



Four Different Material Types	Commercial Series	Automotive Grade Series
Original Series	IHLP - 01	IHLP - A1
Low DCR Series	IHLP - 11	IHLP - 1A
High Temp Series (+155 °C)	IHLP - 51	IHLP - 5A
High Temp Series (+180 °C)	IHLP - 81	IHLP - 8A

IHLP	2525	CZ	ER	1R0	M	01
Series	Footprint (in)	Profile (mm)	Lead (Pb)-free / Packaging	L (μH)	L Tol	Material / Special

NINE FOOTPRINTS AVAILABLE WITH A VARIETY OF HEIGHT OPTIONS

Size	Current rating for 1 μH (A)	Foot-print (mm)	Profile	Profile height (mm)
1212	4.5	3 x 3	AZ, AB, BZ	AZ = 1.0 AB = 1.2
1616	4.5	4 x 4	AB, BZ	AH = 1.8 BZ = 2.0
2020	9.2	5 x 5	AB, BZ, CZ	BD = 2.4 CZ = 3.0
2525	13.0	6 x 6	AH, BD, CZ, EZ	CE = 3.5
3232	18.0	8 x 8	CZ, DZ	DZ = 4.0 EZ = 5.0
4040	20.0	10 x 10	DZ	FD = 6.4
5050	32.0	13 x 13	CE, EZ, FD	GZ = 7.0
6767	48.0	17 x 17	DZ, GZ	MZ = 13.0
8787	69.0	22 x 22	MZ	



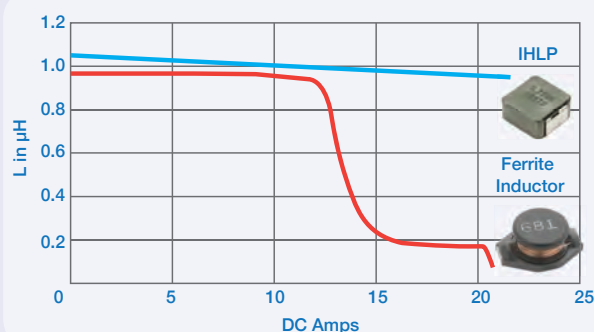
SPACE GRADE IHLP[®] POWER INDUCTORS MIL-STD-981 CLASS S COMPLIANT

IN A NUTSHELL

APPLICATIONS

- Low profile, high current power supplies
- High current POL converters
- DC/DC converters in distributed power systems
- “Flight-ready” solar inverters
- Noise suppression

SATURATION – IHLP[®] VS. FERRITE INDUCTOR



FIVE FOOTPRINTS AVAILABLE

Size	Current Rating for 1 μH (A)	Footprint (mm)	Profile	Profile Height (mm)
24	10.8	6.2 x 6.2	DC	DC = 4.3
48	23.5	12.2 x 12.2	FA	FA = 6.1
60	40.0	15.2 x 15.2	HE	HE = 8.5
73	53.0	18.8 x 18.8	HF	HF = 8.6
97	69.0	24.5 x 24.5	OZ	OZ = 15

SGIHLP [™] Screening Code	Two Different Levels of Screening
1P	Basic Production Screen
1S	MIL-STD-981 Group A / B Full Screen

SGIHLP[™]	97	OZ	B	101	M	8	1P
Product Family	Dimensions (in)	Profile	Packaging	Inductance	Tolerance	Series	Screening Code

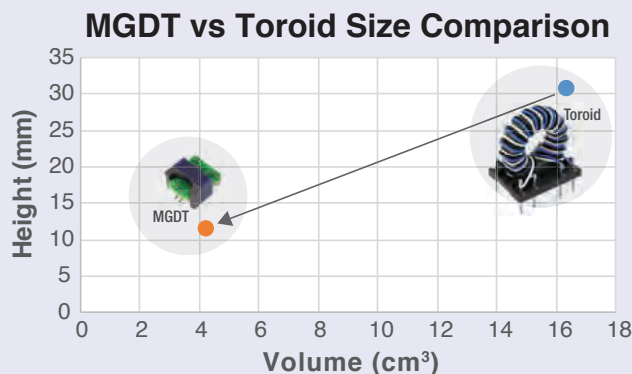
Product and testing can be customized based on your requirements. Contact us!



MINI PLANAR GATE DRIVE TRANSFORMER

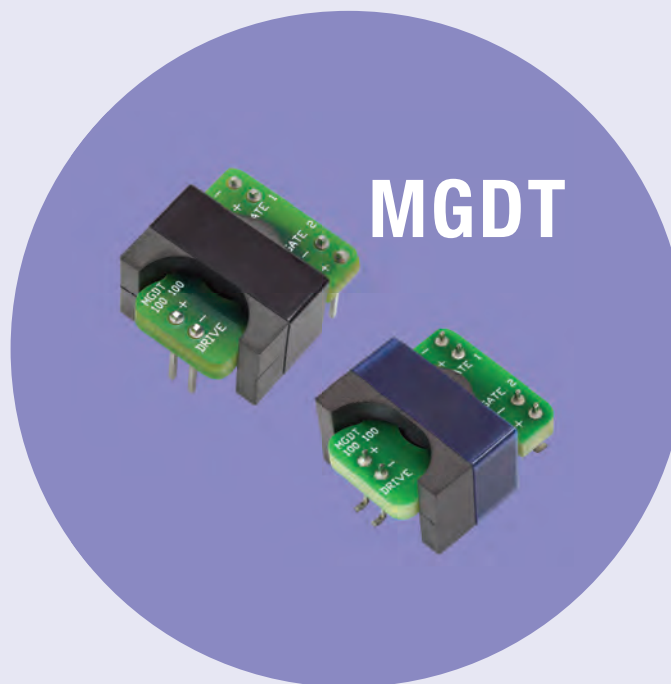
MGDT

IN A NUTSHELL



MGDT 100125

Product Family Turns Ratio



FEATURES

Provides a **high isolation** of **3750 V_{AC}** from drive to gate

3750 V_{AC}

< 12 mm Offers **low profile** gate drive transformer package **< 12 mm**

Excellent **rise time** and **minimal overshoot** capabilities



Very small package, meeting **8 mm** creepage and clearance distance



Almost **4 times smaller** than equivalent toroidal wound design

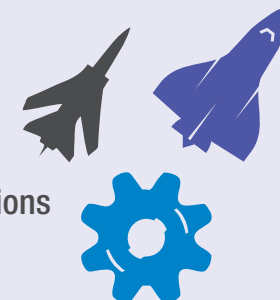
4x

SPECIFICATIONS

PARAMETER	CONDITIONS	LIMITS	UNITS
Dielectric withstand voltage	Drive to gate, 1 min	3750 minimum	V _{AC}
	Gate to gate, 1 min	2500 minimum	V _{AC}
Frequency		100 to 500	kHz
Size (L x W x H)		20.57 x 18.42 x 11.43	mm
Terminals	Through-hole and surface-mount		

APPLICATIONS

- Directly drives high side MOSFETs / IGBTs on busses up to 1200 V
- Isolated power switch in motor drives
- Industrial, military, and aerospace applications





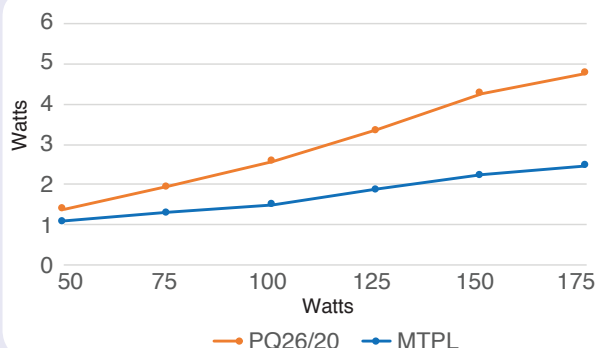
PLANAR TRANSFORMERS

MTPL

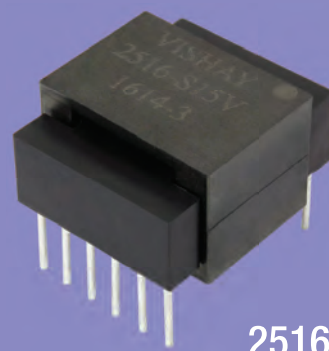
IN A NUTSHELL

POWER LOSS VS. OUTPUT POWER

MTPL VS. BOBBIN WOUND



MTPL



2516

FEATURES

Higher power density levels vs. traditional planar designs

Designed to meet **MIL-PRF-27** requirements

Split primary for **120 V** or **380 V** operation

Low profile, less than **16.5 mm**

Heavy conductor **copper thicknesses** are available for **high current** windings

380 v

120 v



MTPL 2516 S12V

Product Family

W, H Dimensions (mm)

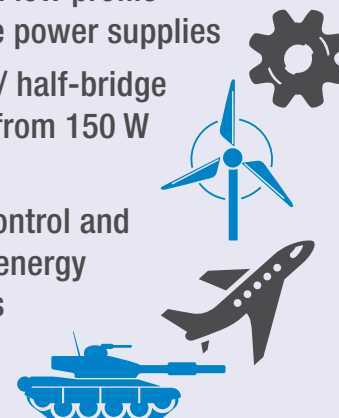
Output Voltage

STANDARD ELECTRICAL SPECIFICATIONS

Part Number	Output Voltage (V)	Magnetizing Inductance min (μH)	Leakage Inductance max (μH)	Interwinding Capacitance max (pF)	Transfer Ratio PRI : Sec	DCR (mΩ)			Rated Current (A)
						2.3 to 4.5	12 to 8	11 to 7	
MTPL-2516-S12V	12	450	1.70	120	0.176	23.0	8	8	22.0
MTPL-2516-S15V	15	450	2.00	120	0.214	28.0	12	12	16.25
MTPL-2516-S24V	24	450	1.30	120	0.333	23.0	25	25	12.5

APPLICATIONS

- PFC-derived low profile switchmode power supplies
- Full-bridge / half-bridge converters from 150 W to 300 W
- Industrial control and alternative energy applications
- Military and avionics applications



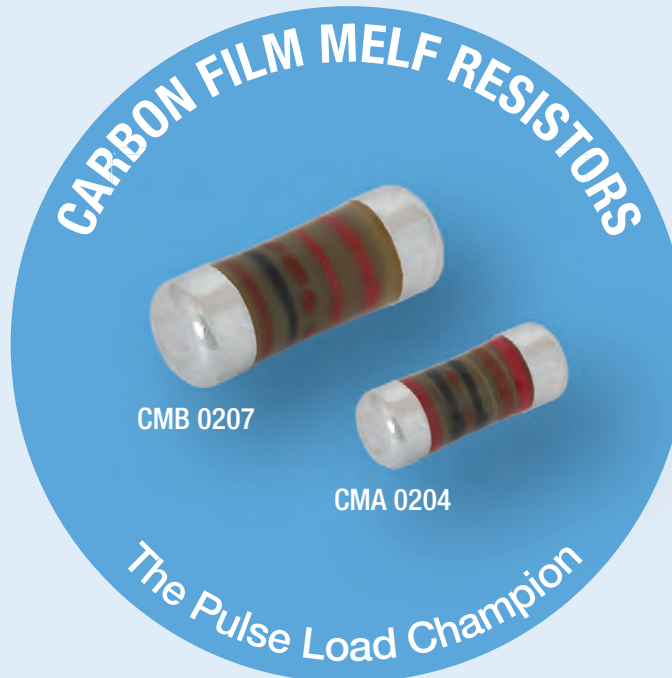
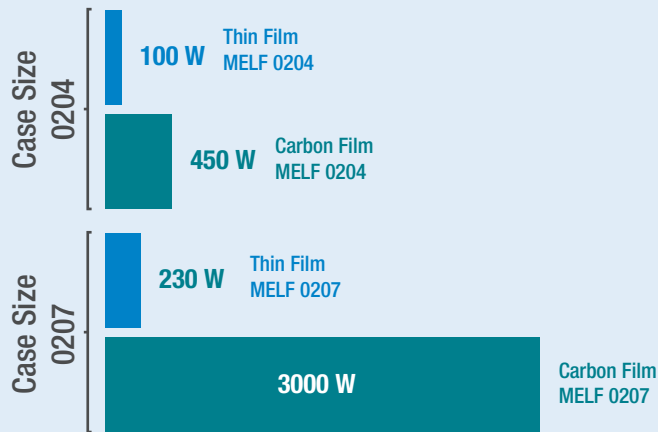


CARBON FILM MELF RESISTORS

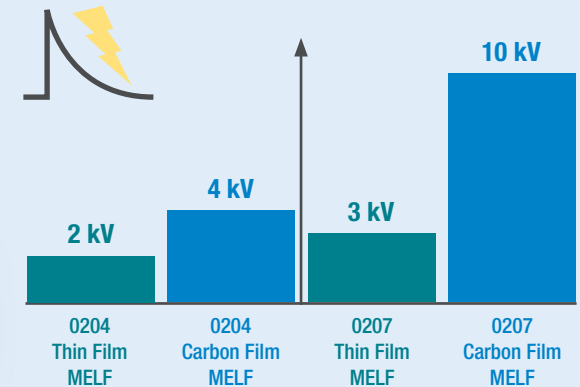
HIGH PULSE LOAD CAPABILITY

IN A NUTSHELL

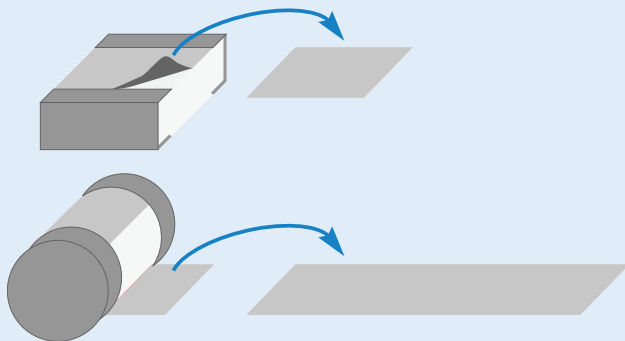
HIGHEST PULSE CAPABILITY FOR SMD FILM RESISTORS



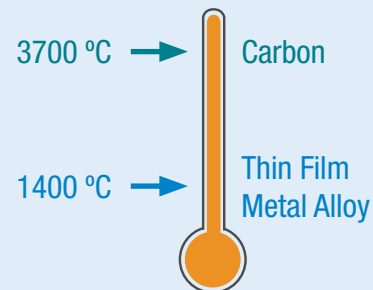
SURGE VOLTAGE CAPABILITY



LARGEST EFFECTIVE RESISTIVE AREA for highest pulse handling capability



CARBON FILM Highest melting point of all elements



SIZE COMPARISON MELF size = Chip size

0204 = ■ = 1206
0207 = ■ = 2512

APPLICATIONS



INVERTERS



I / O PROTECTION



SMART METERS

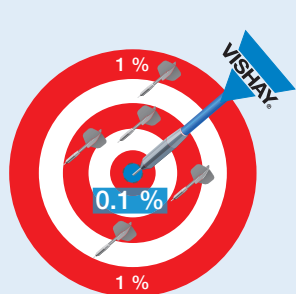


CURRENT SENSE RESISTORS

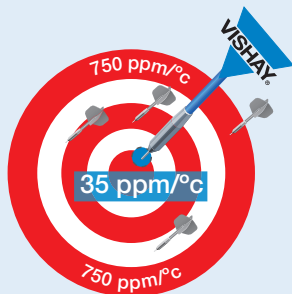
FOR BATTERY MANAGEMENT AND SAFETY

IN A NUTSHELL

PRECISION AND ACCURACY / TCR



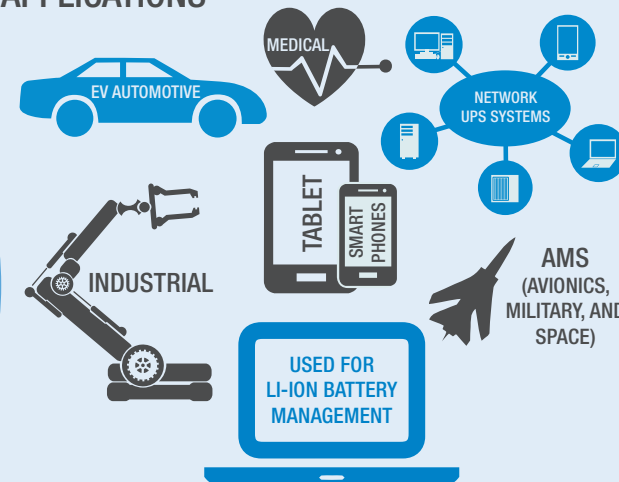
What is your tolerance to accuracy and precision?



Does TCR ruin your design stability?

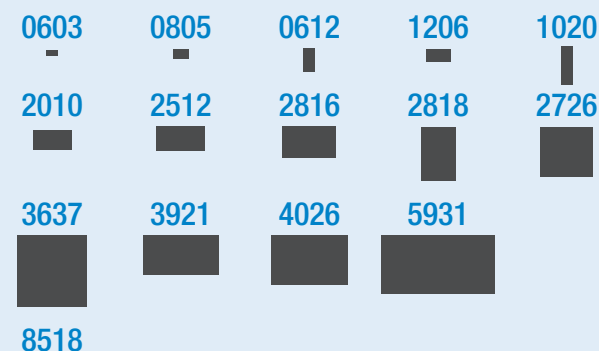


APPLICATIONS



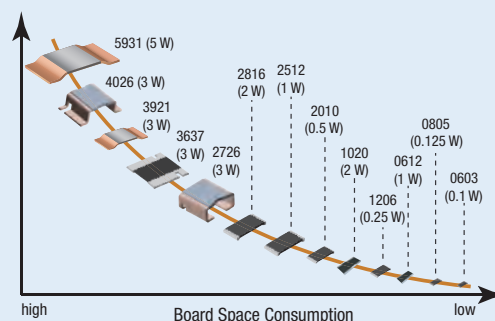
Power Metal Strip Advantages Over Thick Film	Power Metal Strip Advantages Over Thin Film
<ul style="list-style-type: none"> Pulse performance Better temperature derating Superior temperature stability (down to 35 ppm) Low thermal EMF (3 $\mu\text{V}/^\circ\text{C}$) RoHS-compliant without exemption 	<ul style="list-style-type: none"> High power (up to 36 W) Not ESD-sensitive Lower solder joint stress Pulse performance
Power Metal Strip Advantages Over Commercial Foil	
<ul style="list-style-type: none"> Pulse performance Low CTE mismatch with PCB Low resistance (down to 0.05 mΩ) 	

FOOTPRINT



Shown at actual size (when viewed or printed at 100 %)

MULTIPLE PACKAGE SIZES (0603 to 5931)



For Technical Questions: ww2bresistors@vishay.com

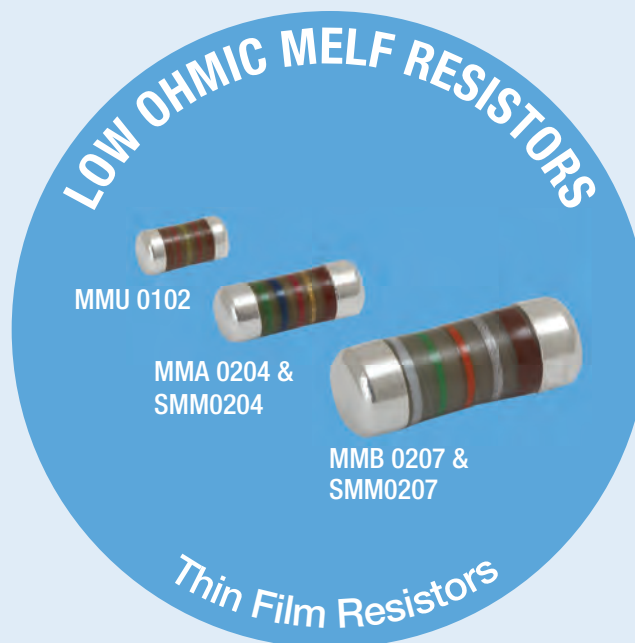
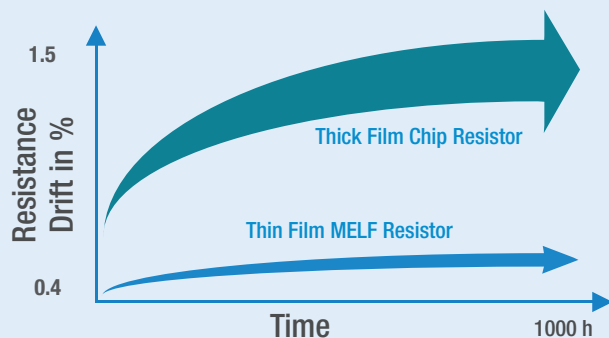


LOW OHMIC MELF RESISTORS

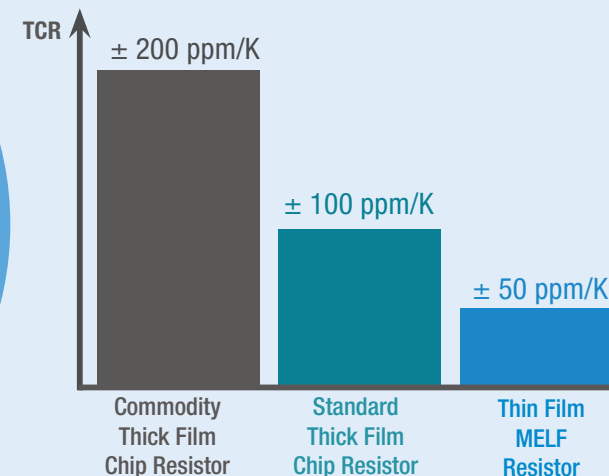
FOR PRECISE CURRENT MEASUREMENT AND EFFICIENT MOSFET GATE DRIVING

IN A
NUTSHELL

EXCELLENT LONG TERM STABILITY



LOW TEMPERATURE COEFFICIENT



APPLICATIONS

Current Measurement in:



LED Drivers



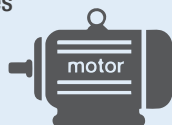
DC/DC
Converters



Battery Management



Electric Vehicles



Motor Drivers



Power Amplifiers

IGBT / MOSFET Gate Resistor in:

SIZE COMPARISON

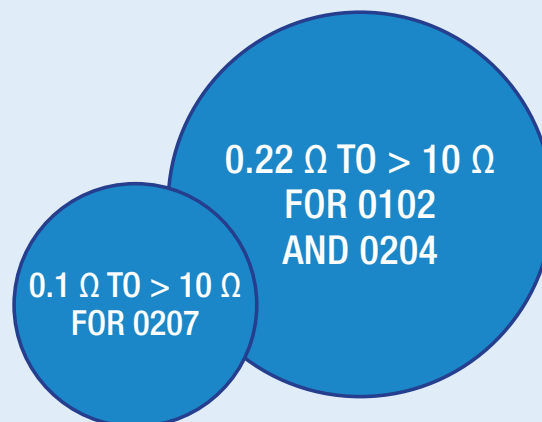
MELF Size = Chip Size

0102 = ■ = 0805

0204 = ■ = 1206

0207 = ■ = 2512

RESISTANCE VALUES



For Technical Questions: melf@vishay.com



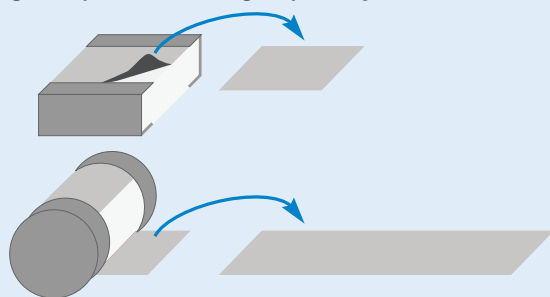
MELF RESISTORS FOR PULSE LOAD APPLICATIONS

IN A NUTSHELL

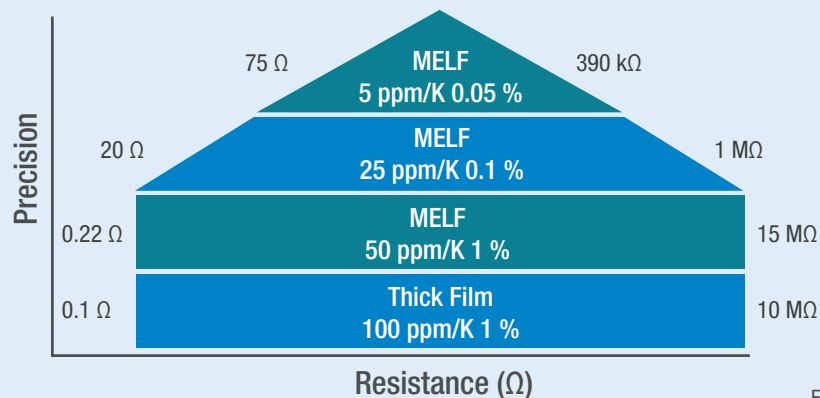
SUPERIOR PULSE CAPABILITY



LARGEST EFFECTIVE RESISTIVE AREA for highest pulse handling capability



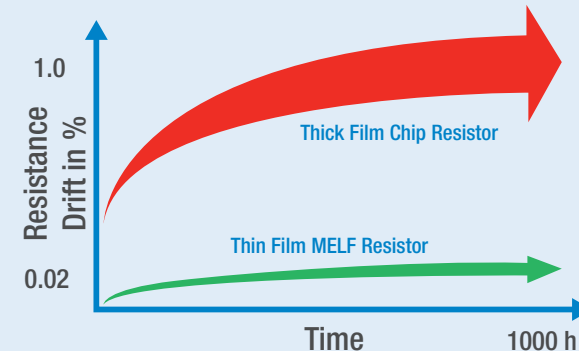
RESISTANCE RANGE AVAILABILITY



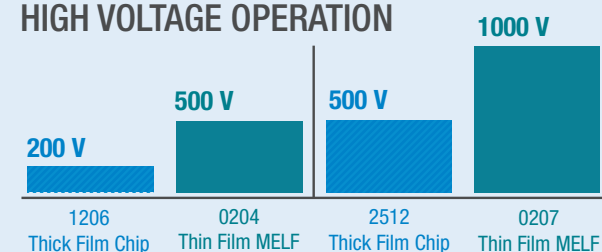
MELF RESISTORS



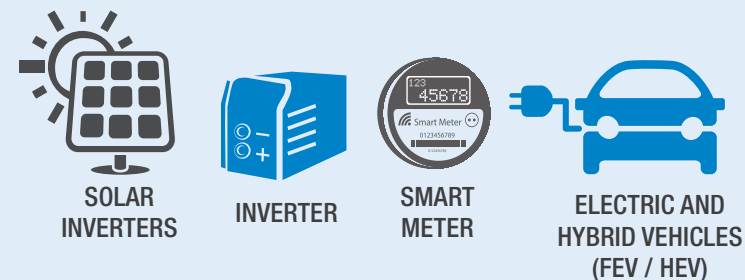
EXCELLENT LONG TERM STABILITY



HIGH VOLTAGE OPERATION



APPLICATIONS



SIZE COMPARISON

MELF size = chip size

0102 = ■ = 0805

0204 = ■ = 1206

0207 = ■ = 2512

For Technical Questions: melf@vishay.com

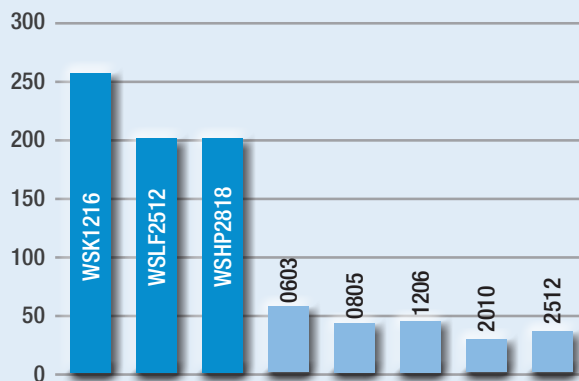


CURRENT SENSE RESISTORS

HIGH POWER DENSITY, LOW RESISTANCE

IN A NUTSHELL

POWER DENSITY (W/in²) vs.
STANDARD POWER RATED SIZES



Vishay Automotive Grade
Exceeds AEC-Q200

BENEFITS OF POWER METAL STRIP®

- All-metal welded construction provides superior pulse tolerance
- Extremely low resistance values — minimizes power loss and prevents parallel resistance elements
- Low TCR — better temperature stability
- Tight tolerance — improves measurement accuracy
- Laser trimmed — enables design flexibility

POWER METAL STRIP®



FOOTPRINT

WSLF2512

WSK1216

WSHP2818

Shown at actual size

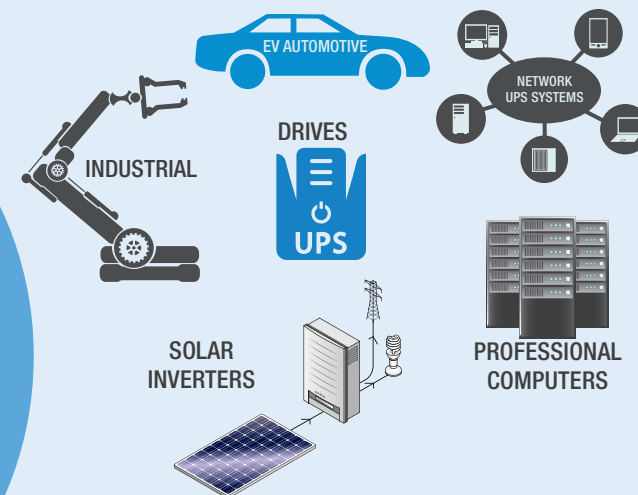
BENEFIT

Replace (2) high power 2512

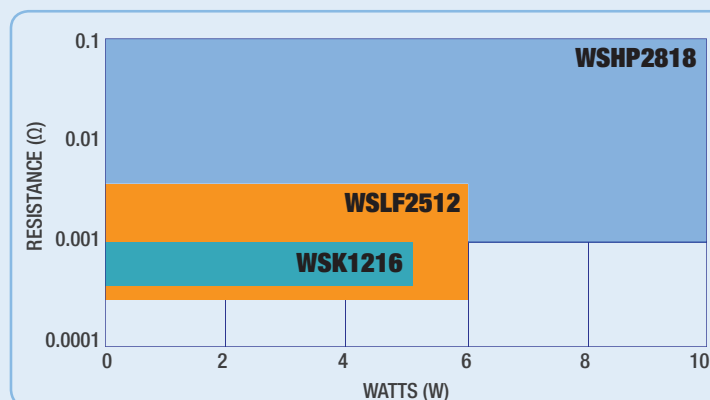
4-terminal / TCR performance

Flexible resistance range and high power capability

APPLICATIONS



POWER RATING vs. RESISTANCE RANGE



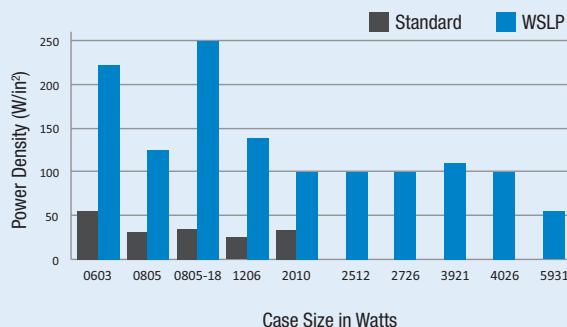


CURRENT SENSE RESISTORS

HIGH POWER, LOW RESISTANCE

IN A NUTSHELL

POWER DENSITY



WSLP SERIES



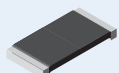
WSLP5931

High Power



WSLP2726

Kelvin 4-Terminal Connection



WSLP2512

Standard Size

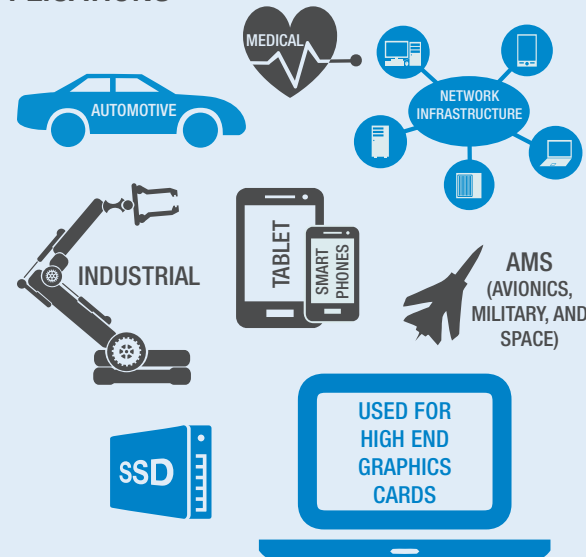


WSLP0603

Small Size

Power Metal Strip®

APPLICATIONS



Power Metal Strip® Advantages Over Thick Film

- Pulse performance
- Better temperature derating
- Superior temperature stability (down to 75 ppm)
- Low thermal EMF (3 $\mu\text{V}/^\circ\text{C}$)
- RoHS-compliant without exemption

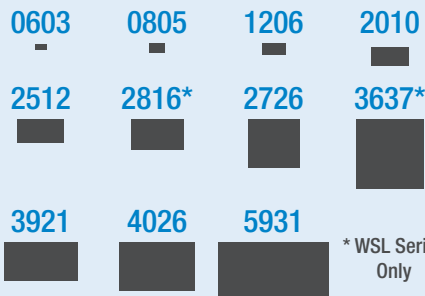
Power Metal Strip® Advantages Over Thin Film

- High power (up to 10 W)
- Not ESD-sensitive
- Lower solder joint stress
- Pulse performance

Power Metal Strip® Advantages Over Commercial Foil

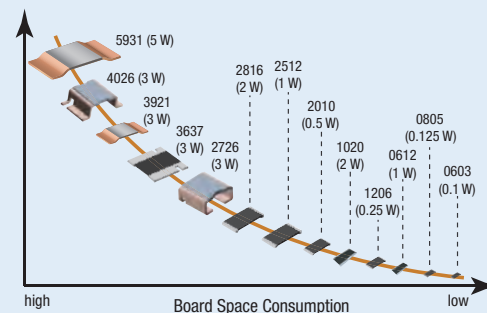
- Pulse performance
- Low CTE mismatch with PCB
- Low resistance (down to 0.2 m Ω)

FOOTPRINT



* WSL Series Only

MULTIPLE PACKAGE SIZES (0603 to 5931)



Shown at actual size (when viewed or printed at 100 %)

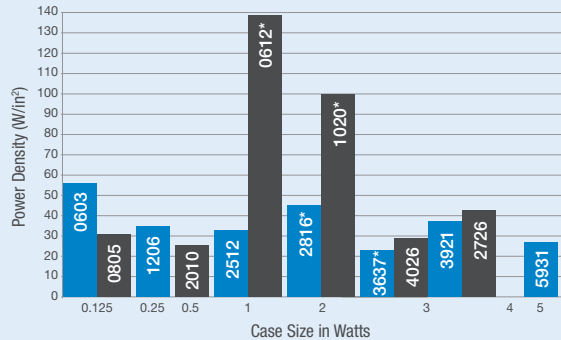


CURRENT SENSE RESISTORS

HIGH POWER, LOW RESISTANCE

IN A NUTSHELL

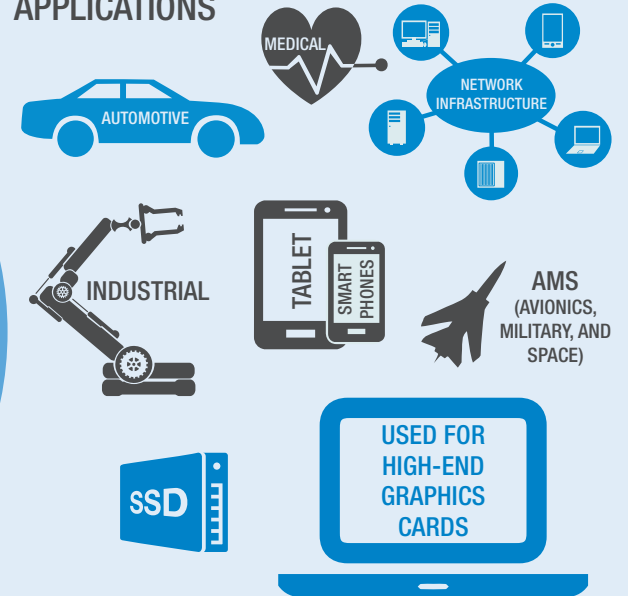
POWER DENSITY



WSL SERIES



APPLICATIONS



Power Metal Strip® Advantages Over Thick Film

- Pulse performance
- Better temperature derating
- Superior temperature stability (down to 75 ppm)
- Low thermal EMF (3 $\mu\text{V}/^\circ\text{C}$)
- RoHS-compliant without exemption

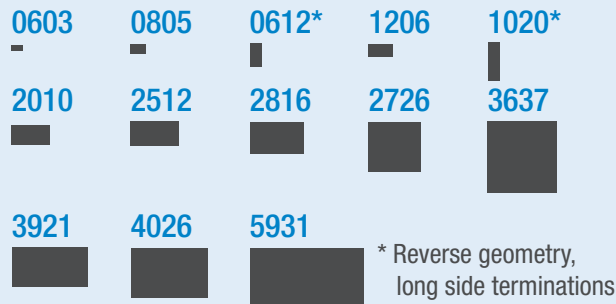
Power Metal Strip® Advantages Over Thin Film

- High power (up to 5 W)
- Not ESD-sensitive
- Lower solder joint stress
- Pulse performance

Power Metal Strip® Advantages Over Commercial Foil

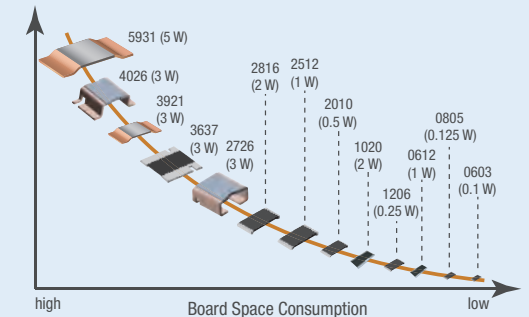
- Pulse performance
- Low CTE mismatch with PCB
- Low resistance (down to 0.2 m Ω)

FOOTPRINT



Shown at actual size (when viewed or printed at 100 %)

MULTIPLE PACKAGE SIZES (0603 to 5931)



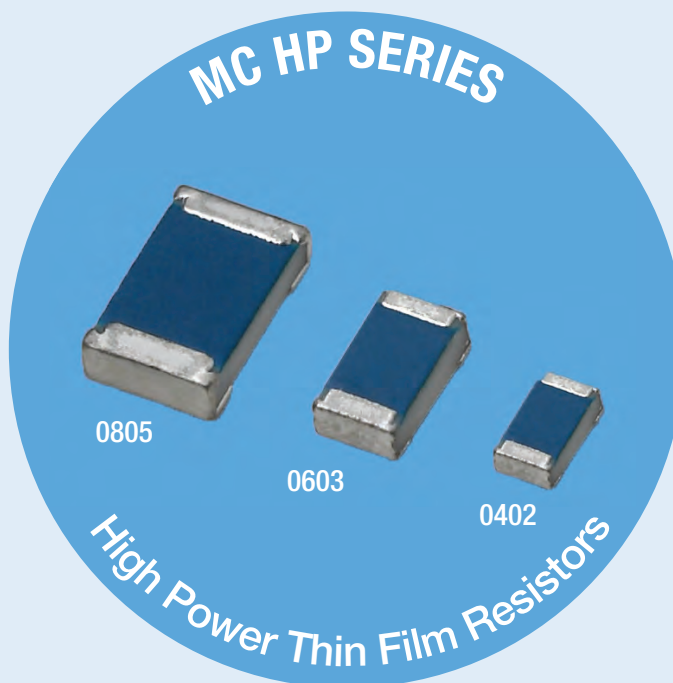
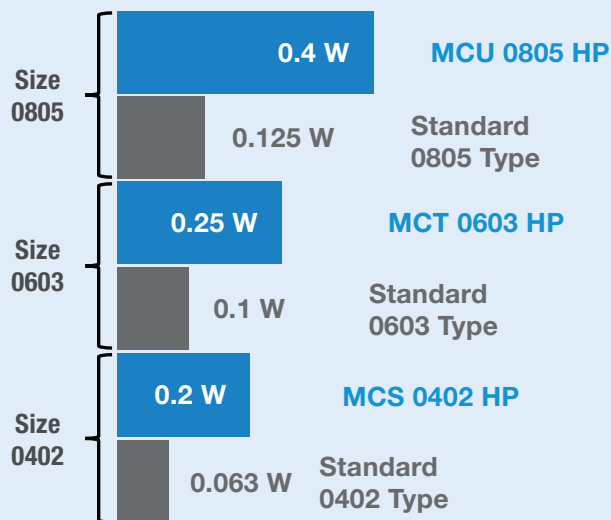


HIGH POWER THIN FILM RESISTORS

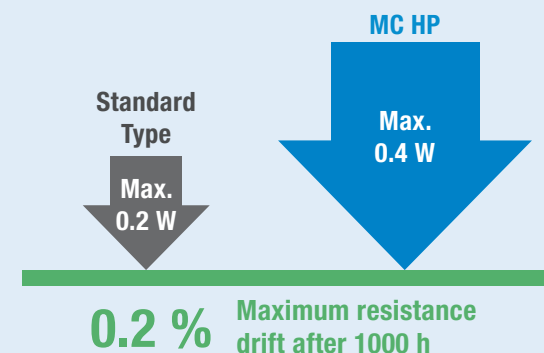
EXCELLENT STABILITY IN HIGH POWER APPLICATIONS

IN A NUTSHELL

SUPERIOR POWER RATING



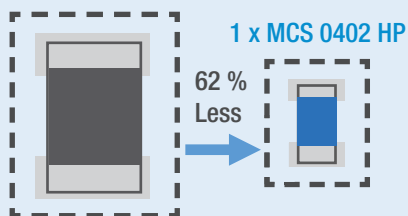
EXCELLENT LONG TERM STABILITY At Increased Power Rating



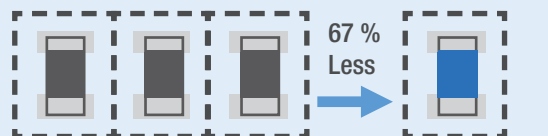
SPACE SAVING

Reduce Component Count and Save Board Space for 0.2 W Rated Power

1 x standard 0805 type



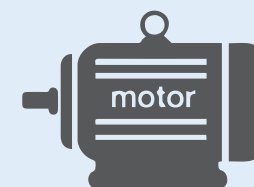
3 x standard 0402 type



APPLICATIONS



AUTOMOTIVE



DRIVES



DC/DC CONVERTERS



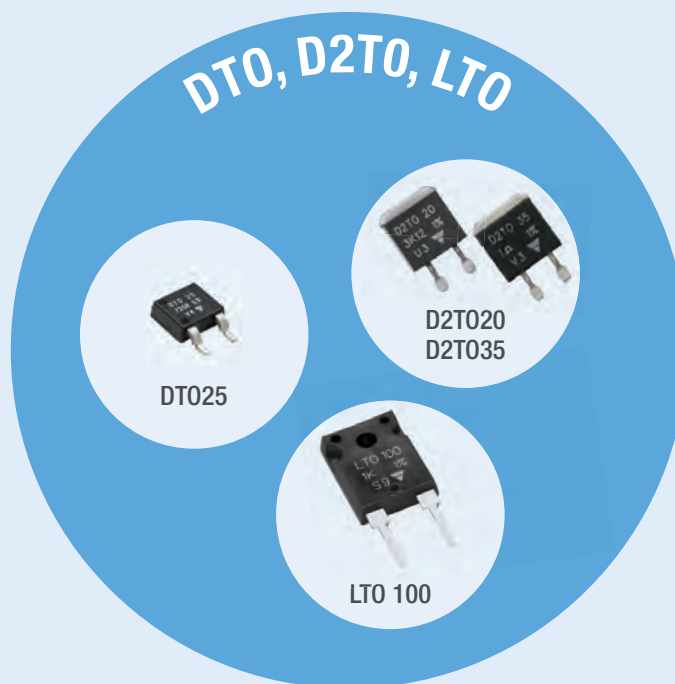
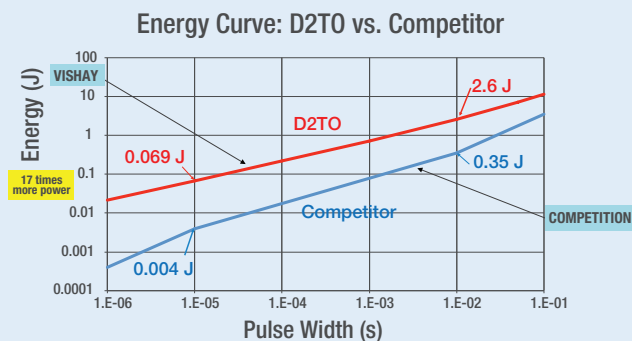
INVERTERS



THICK FILM POWER RESISTORS

AEC-Q200 POWER RESISTORS

IN A NUTSHELL



PROVEN QUALITY



AEC-Q200 qualified

With PPAP available



Driving the main EV / HV manufacturers

PROVEN RELIABILITY

27 severe AEC-Q200 tests passed



NON-INDUCTIVE



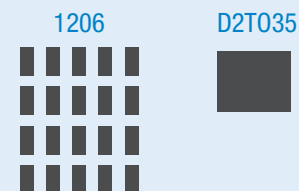
Widest Ω range

SPACE SAVING



Fewer components on PCB

Can replace 5 to 20 chip resistors



APPLICATIONS



AMS

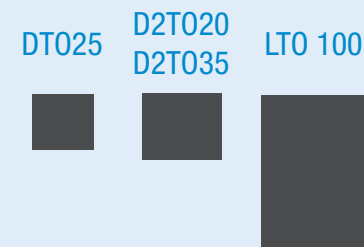


INDUSTRIAL



AUTOMOTIVE

FOOTPRINT



Shown at actual size (when viewed or printed at 100 %)

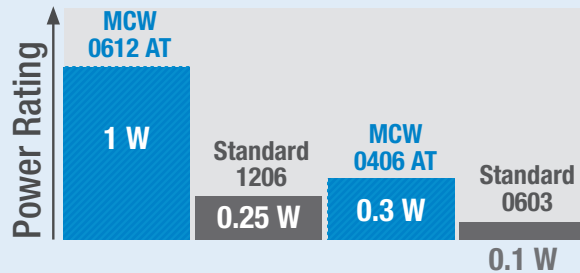


WIDE TERMINAL THIN FILM RESISTORS

HIGH POWER, SPACE SAVING

IN A NUTSHELL

SUPERIOR POWER RATING



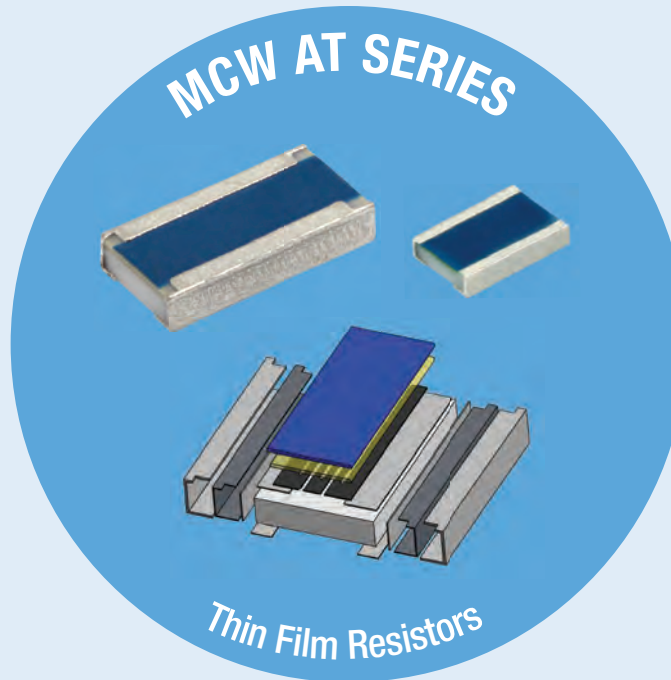
ADVANCED THERMAL CYCLING



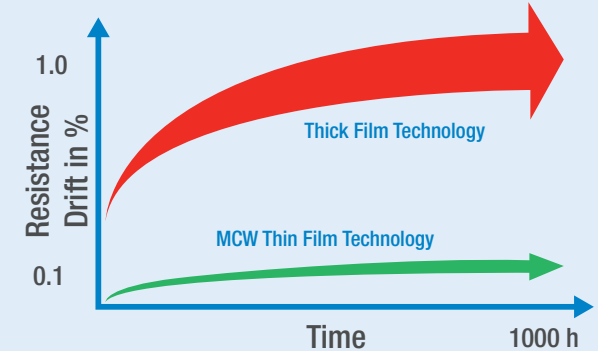
MCW 0406 AT - **3000** cycles

MCW 0612 AT - **2000** cycles

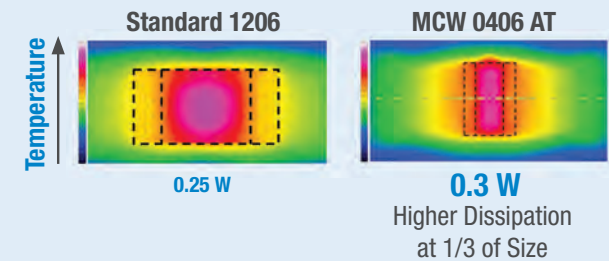
Standard 1206 case size - **1000** cycles



EXCELLENT LONG TERM STABILITY

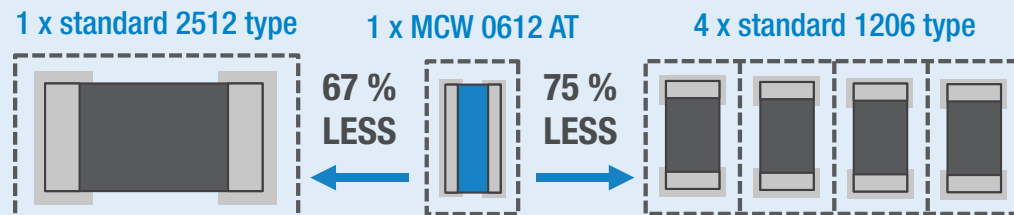


HIGHER POWER DISSIPATION

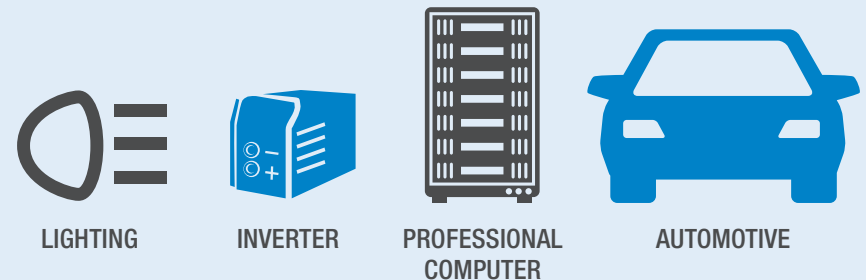


SPACE SAVING

Component Count and Board Space for 1 W Rated Power



APPLICATIONS



For Technical Questions: thinfilmchip@vishay.com



CDMM

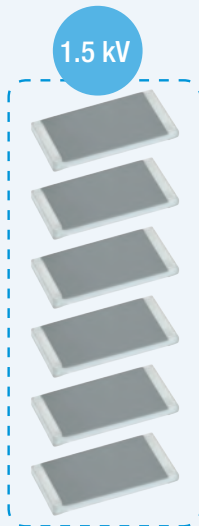
HIGH VOLTAGE MOLDED CHIP DIVIDER

IN A NUTSHELL

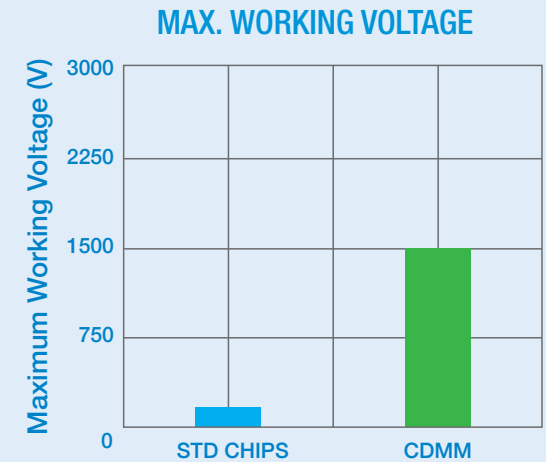
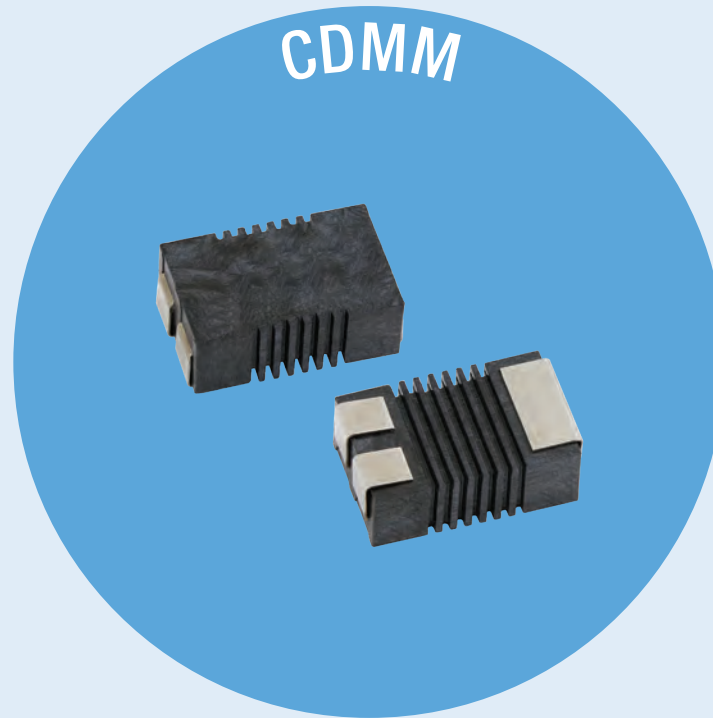
6 - 8
STANDARD
RESISTORS

=

1
CDMM
MEANS
MORE
SPACE



1 CDMM resistor rated
at 1500 V each

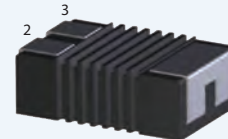
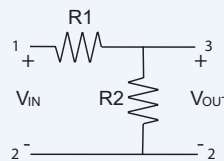
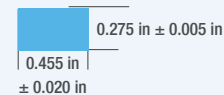


FEATURES

- Specifically designed for EV and HV automotive applications
- AEC-Q200 qualified
- Compliant terminations
- Sulfur-resistant
- High creepage distance
- Wide resistance values and ratios
- Good TCR tracking and ratio tolerances vs. individual components

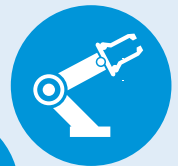
FOOTPRINT

Shown at actual size



APPLICATIONS

- Industrial
- Consumer
- Automotive





CDMx (CDMM, CDMP, CDMH) SERIES HIGH VOLTAGE MOLDED CHIP DIVIDER

IN A NUTSHELL

5 - 15
STANDARD
RESISTORS



1
CDMx

MEANS
MORE
SPACE



1 CDMx resistor rated @
1100 V to 3000 V each

HIGH
PRECISION



CDMP
CDMM
CDMH

VOLTAGE
HANDLING



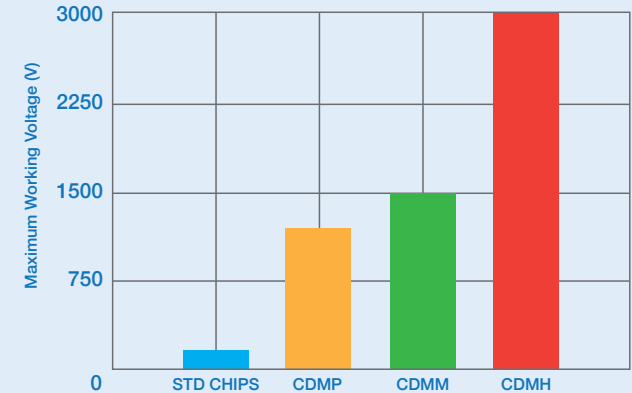
CDMH
CDMM
CDMP

COST



CDMP
CDMH
CDMM

MAX. WORKING VOLTAGE

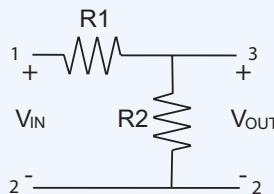
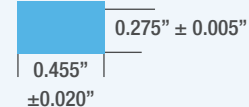


FEATURES

- Specifically designed for EV and HV automotive applications
- AEC-Q200 qualified
- Sulfur-resistant
- Wide resistance values and ratios
- Good TCR tracking and ratio tolerances vs. individual components
- High creepage distance

FOOTPRINT

Shown at actual size

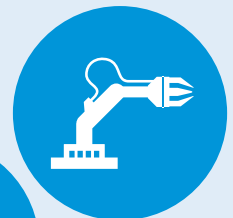


4527



APPLICATIONS

- Industrial
- Consumer
- Automotive





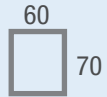
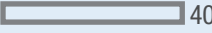
For Technical Questions: te1resistors@vishay.com

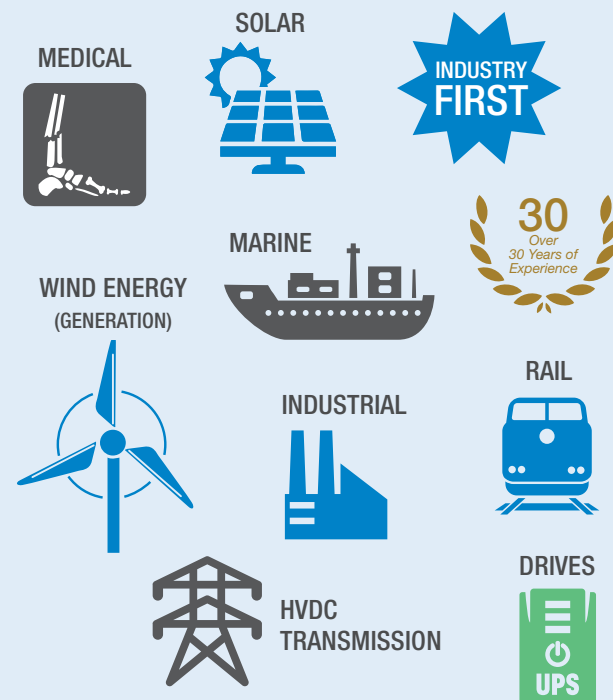
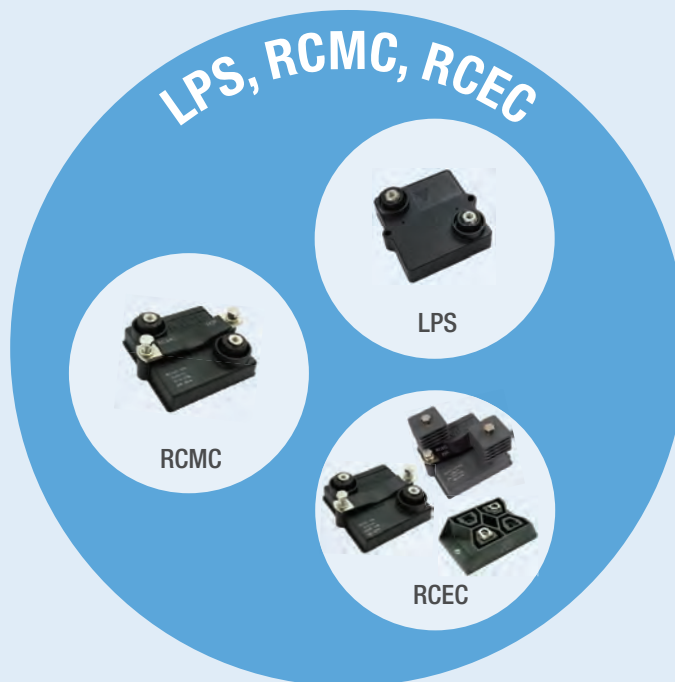


THICK FILM POWER RESISTORS

HIGH POWER, COMPACT THICK FILM RESISTORS

**IN A
NUTSHELL**

	RCEC 750	Wirewound
	750 W	750 W
Size		
Footprint		
Weight	100 g	1400 g
Case Temp.	70 °C	450 °C
Inductance	Non-inductive	Inductive
Resistance	0.3 Ω to 1 MΩ	8.2 Ω to 60 kΩ
Dielectric	Up to 12 kV	Not insulated
Partial Discharge	< 5 pC	> 1000 pC

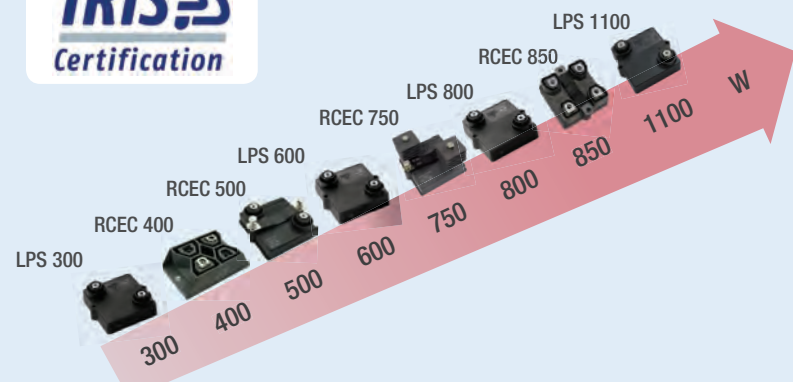


CUSTOM FRIENDLY

- Specific terminals (size and diameter M4 - M5)
- Terminals with leads
- Possibility of two or three resistors in the same case (RCEC 400, RCEC 850)
- Creeping and clearance distances (HV version)
- Assemblies (resistors mounted on heatsink)

KEY APPLICATIONS

- ✓ Snubbers
- ✓ Discharge
- ✓ Balancing
- ✓ Dividers
- ✓ Filters

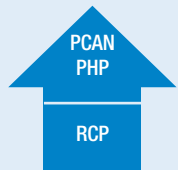




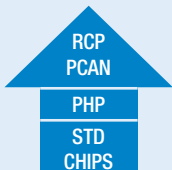
HIGH POWER RESISTORS

RCP / PHP / PCAN

HIGH
PRECISION



POWER
RATING



PCAN

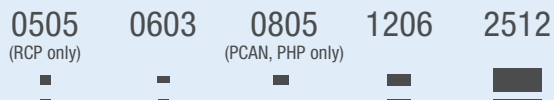
PHP ~ RCP

COST

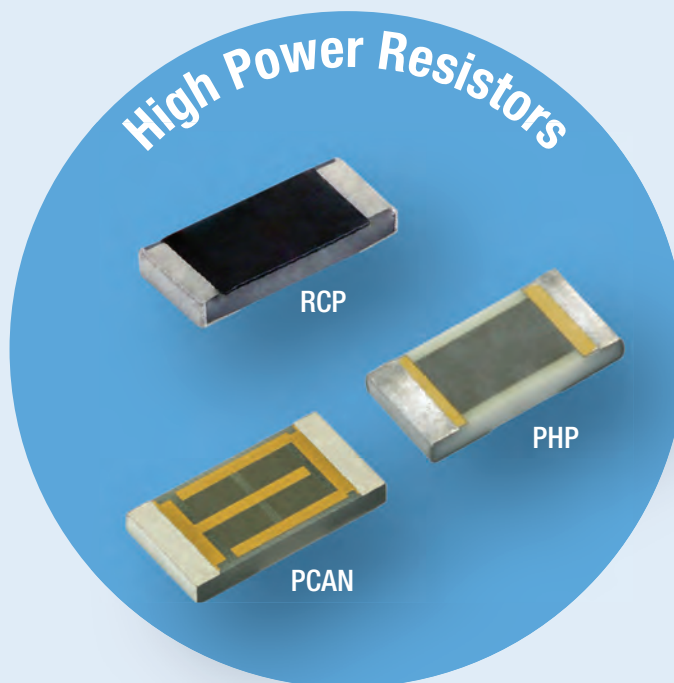
REDUCES COMPONENT COUNT
AND PCB AREA



FOOTPRINT AND PROFILE CAPABILITY

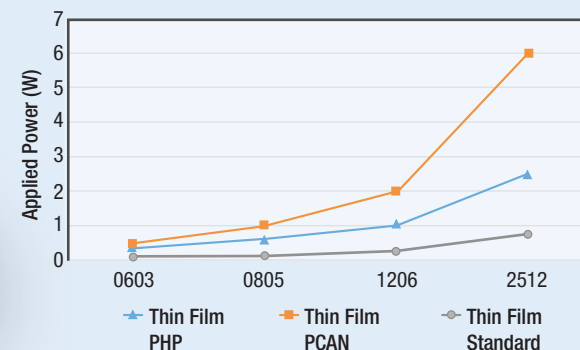


Shown at actual size (when viewed or printed at 100 %)



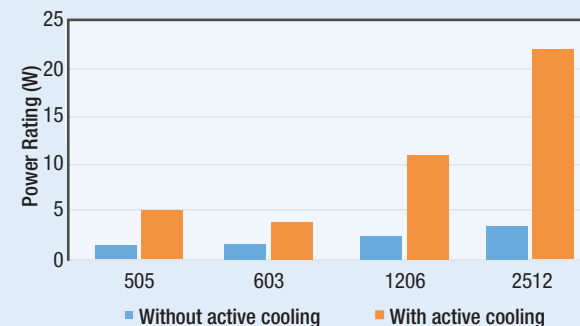
IN A NUTSHELL

PHP AND PCAN THIN FILM RESISTORS
RATED POWER AT 70 °C



* Without active cooling

RCP (AlN) THICK FILM CHIP RESISTOR
POWER RATING



APPLICATIONS



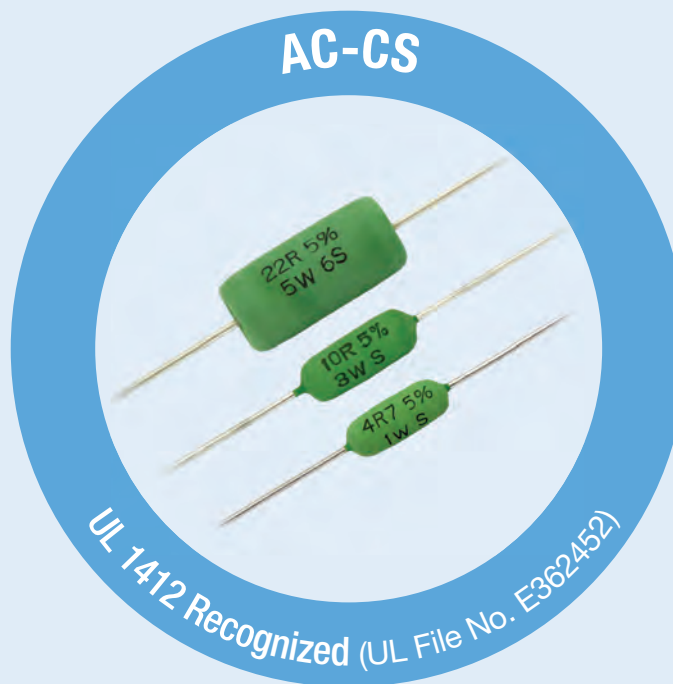
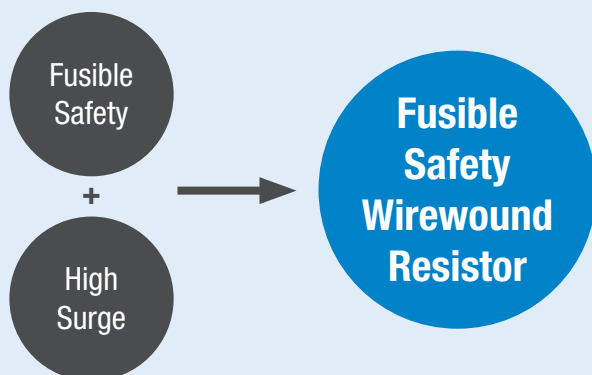
For Technical Questions: thinfilm@vishay.com



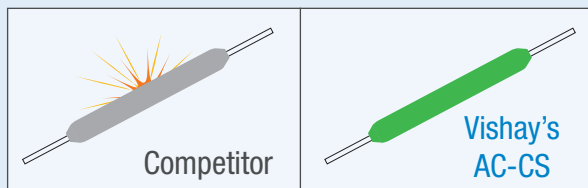
FUSIBLE SAFETY WIREWOUND RESISTORS

SILENT + SAFE FUSING, SURGE HANDLING UP TO 6 kV

IN A NUTSHELL



SAFE + SILENT FUSING



AC-CS OPTIONS

	Rated Power, P_{40}	Surge Voltage Max.	Fusing Time	Ohmic Range	Diameter	Length
AC01-CS	1.1 W	0.7 kV to 3.2 kV	< 30 s for 30 W overload	3 Ω to 100 Ω , 5 %	5 mm	11 mm
AC03-CS	3 W	2 kV to 4 kV	< 25 s for 45 W overload	4.7 Ω to 100 Ω , 5 %	6 mm	13 mm
AC05-CS	5 W	4 kV (10 Ω to 20 Ω) 6 kV (22 Ω to 100 Ω)	< 45 s for 100 W overload	10 Ω to 100 Ω , 5 %	10 mm	17 mm

Detailed datasheet: www.vishay.com/doc?28909

KEY APPLICATIONS IN ALTERNATIVE ENERGY, CONSUMER, AND INDUSTRIAL



Energy Meters



Gas Meters



Washing Machines



Power Supplies

FOOTPRINT

AC01-CS



AC03-CS



AC05-CS



Shown at actual size
(when viewed or printed at 100 %)



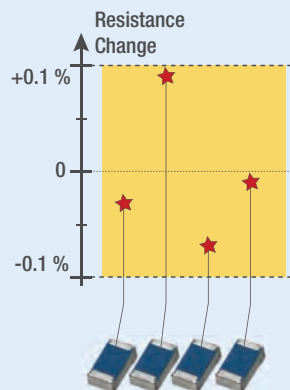
RESISTOR ARRAYS

WHEREVER A STABLE RESISTANCE RATIO IS REQUIRED

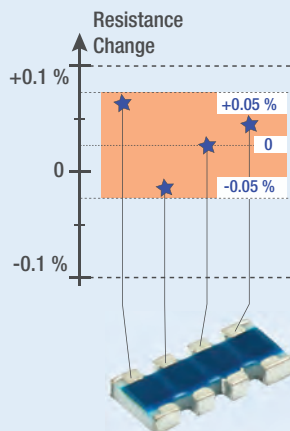
IN A
NUTSHELL

TOLERANCE

Absolute Tolerance

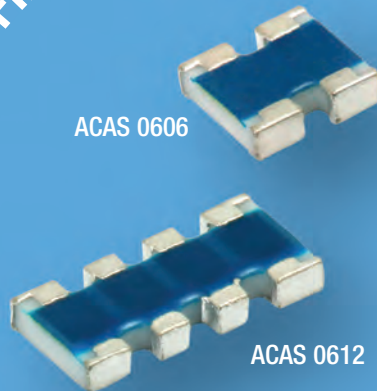


Relative Tolerance (Matching)



THIN FILM CHIP RESISTOR ARRAYS

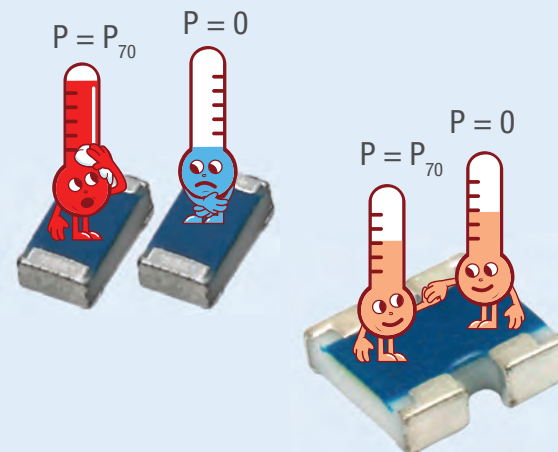
ACAS 0606



ACAS 0612

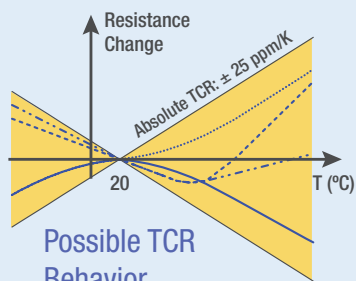
With Four or Eight Terminals

THERMAL COUPLING



TEMPERATURE COEFFICIENT

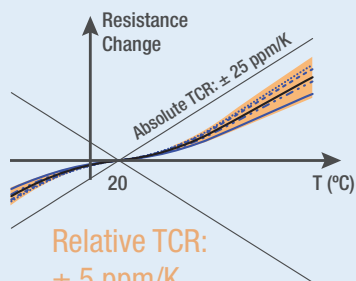
Absolute TCR



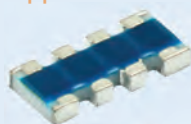
Possible TCR Behavior



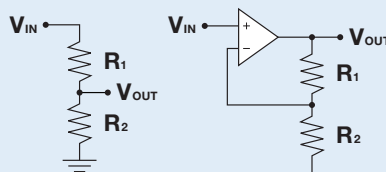
Relative TCR (Tracking)



Relative TCR:
 $\pm 5 \text{ ppm/K}$



APPLICATIONS



VOLTAGE DIVIDER

FEEDBACK LOOP



AUTOMOTIVE



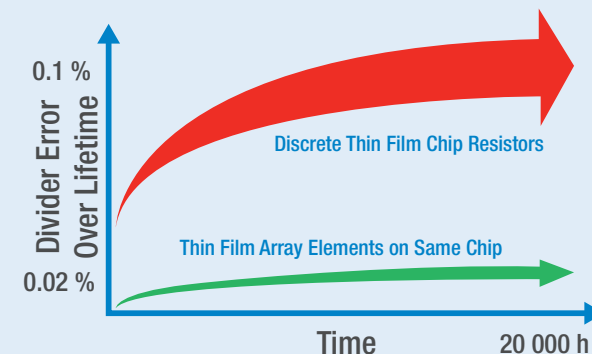
DC/DC
CONVERTERS



MEASUREMENT
EQUIPMENT

EQUIVALENT AGING DRIFT

Divider Ratio Stability: Aging Over Lifetime

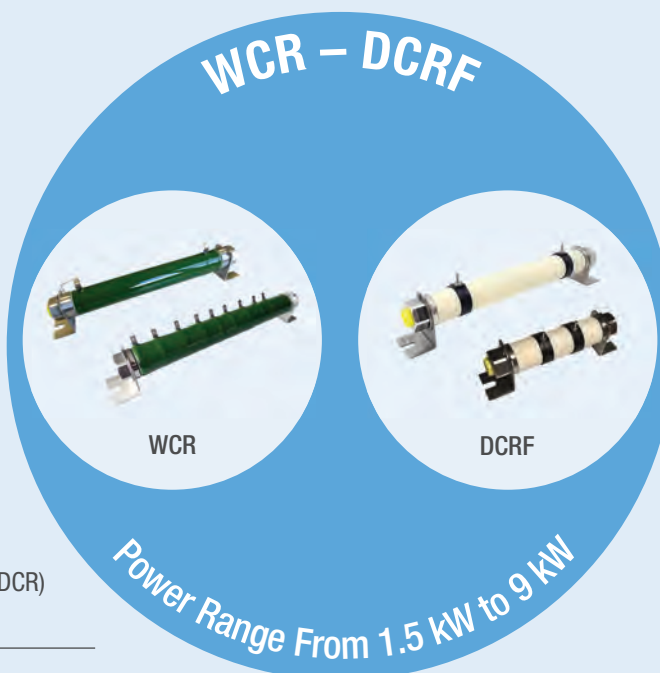
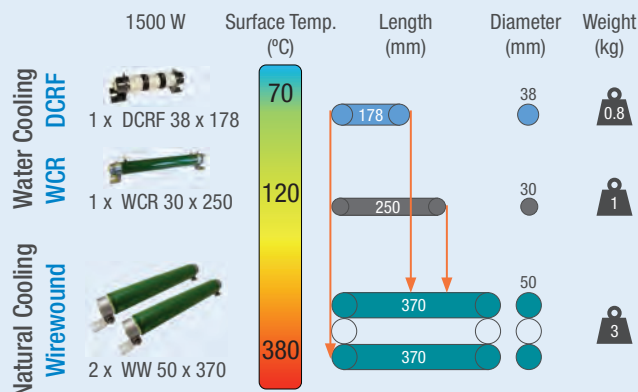




WATER-COOLED WIREWOUND RESISTORS

ULTRA HIGH POWER INTEGRATED RESISTORS

IN A NUTSHELL



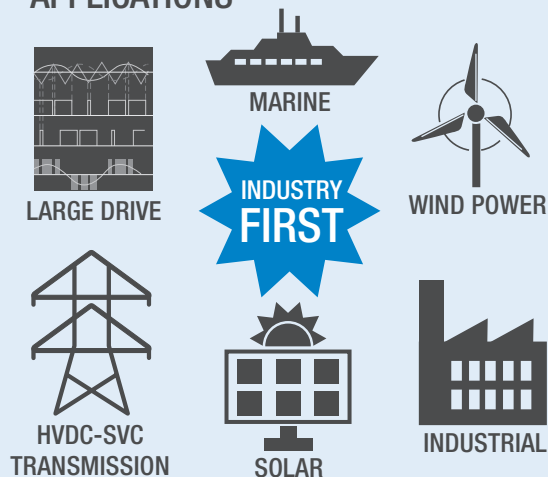
CUSTOMIZATION OPTIONS

- Multiple resistive elements on the same tube (up to eight)
- Combination possible with WCR and DCRF resistive elements (MDCR)
- Custom assemblies (twin tubes)

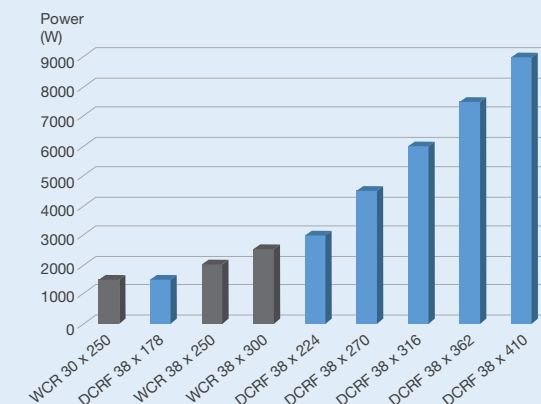
INTEGRATED SOLUTION, NO HEATSINK NEEDED

WCR and DCRF Advantages Over Thick Film Water-Cooled Resistors	WCR and DCRF Advantages Over Plastic Box Water-Cooled Resistors
<ul style="list-style-type: none"> • Pulse performance (wirewound technology) • High power dissipation (up to 9 kW) • Overload capability (2 Pn during 60 s) • Multiple resistive element option (low and high ohmic values on the same support) • Safe failure mode (no leakage) 	<ul style="list-style-type: none"> • High power dissipation (up to 9 kW) • Overload capability (2 Pn during 60 s) • Low inductivity option (< 500 nH) • Multiple resistive element option (low and high ohmic values on the same support) • Safe failure mode (no leakage)
WCR and DCRF Advantages Over Standard Wirewound Resistors	
<ul style="list-style-type: none"> • High power dissipation (up to 9 kW) • Limited external radiation (surface temperature < 120 °C) • Helps customers gain competitive advantage by reducing equipment size and cost • Multiple resistive element option (low and high ohmic values on the same support) 	

APPLICATIONS



PRODUCT PORTFOLIO



For Technical Questions: mcbfixedresistors@vishay.com

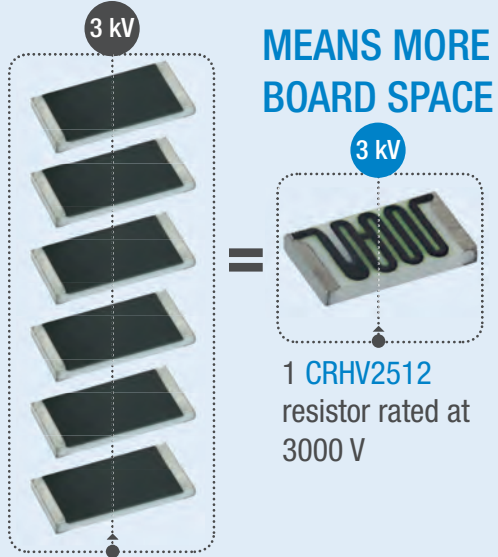


CRHV / CRMV SERIES

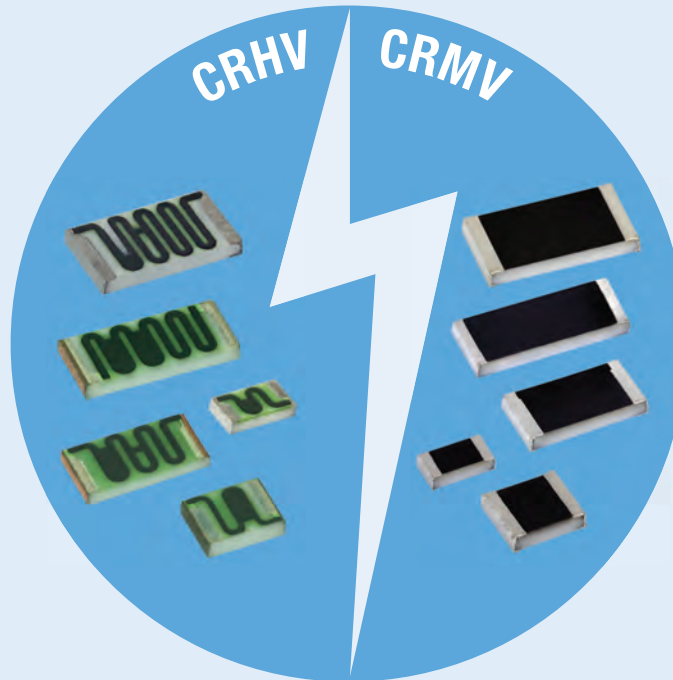
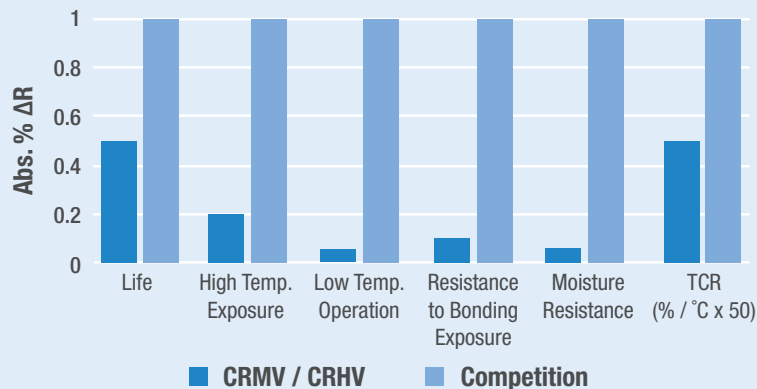
HIGH VOLTAGE THICK FILM RESISTORS

IN A NUTSHELL

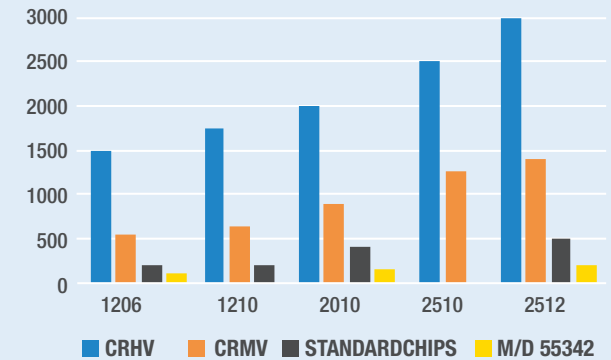
6 Standard Resistors = 1 CRxV



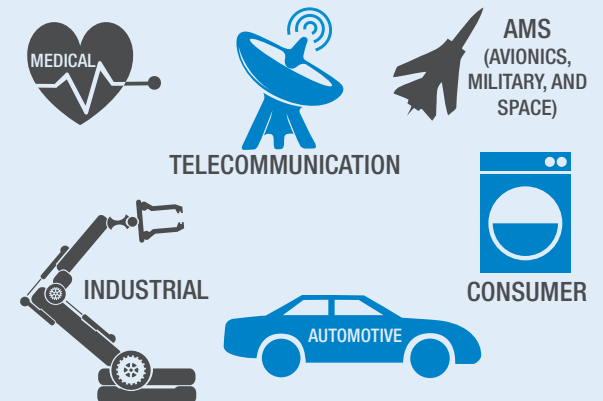
6 STANDARD resistors rated at 500 V each



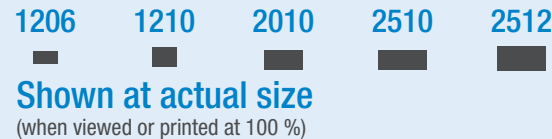
VOLTAGE HANDLING



APPLICATIONS



FOOTPRINT



- Design flexibility with multiple termination configurations and materials including non-magnetic, allows design flexibility
- Available as chip divider also – CDHV and CDMV, respectively

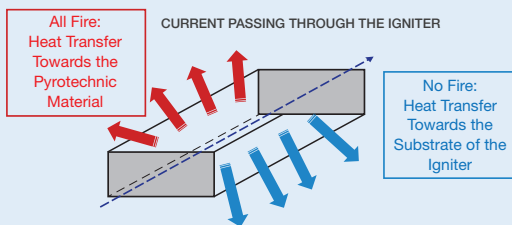


ELECTRO-PYROTECHNIC INITIATOR CHIP RESISTOR

SMD IGNITER

IN A NUTSHELL

The Active Area of an Igniter Is a
Volume of Resistive Element to Heat



ADVANTAGES OF EPIC / MEPIC OVER WIRE BRIDGE

EASY TO MOUNT

STD SMD CASES
(0603 / 0805)

TAPE AND REEL PACKING FOR PICK AND PLACE MACHINES

STD REFLOW PROCESS

CUSTOMIZATION

ADAPTATION OF OUR ACTIVE AREA TO "ALL FIRE / NO FIRE" CUSTOMER REQUIREMENTS

CUSTOMIZATION HAS NO IMPACT ON THE FOOTPRINTS

COMPATIBLE TO ALL EXPLOSIVE MATERIALS

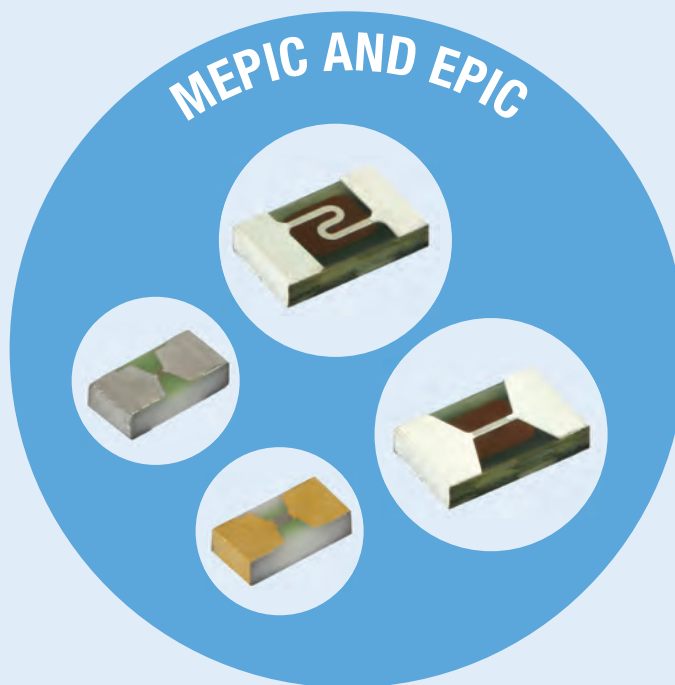
RELIABILITY – REPRODUCIBILITY

RELIABILITY & PREDICTABILITY IN THE SOLDERING PROCESS

DIMENSION OF ACTIVE AREA 100 % CONTROLLED

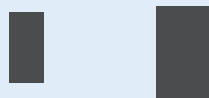
EACH YEAR WE CONTRIBUTE TO SAVING 5000 LIVES WITH OUR TECHNOLOGY

MEPIC AND EPIC



MEPIC: MASSIVE ELECTRO-PYROTECHNIC INITIATOR CHIP RESISTOR
EPIC: ELECTRO-PYROTECHNIC INITIATOR THIN FILM CHIP RESISTOR

EPIC 0603 MEPIC 0805



PERFORMANCE

	EPIC	MEPIC
All Fire Energy	Down to 50 μ J	Down to 1000 μ J
Time	Down to 50 μ s	Down to 250 μ s
No Fire Current	0.3 A to 0.8 A	0.5 A to 1.2 A
No Fire Duration	2 s to 5 s	2 s to 10 s
	Faster and lower energy needed for ignition	Withstands higher energy without ignition

APPLICATIONS (DOMAIN SPECIFIC)



PYROTECHNICS



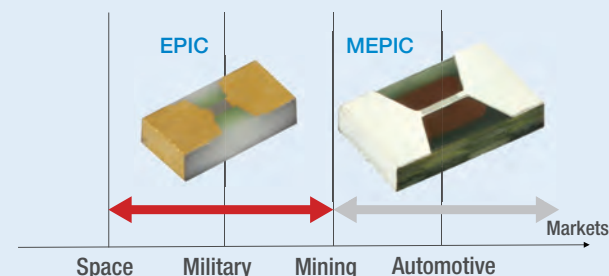
DEMOLITION
ROCK FRAGMENTATION



MILITARY



AIRBAGS
SEAT BELTS



For Technical Questions: sferthinfilm@vishay.com



UIPMA-UFPMA SERIES

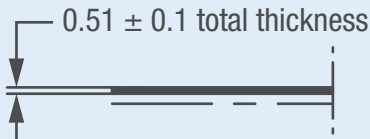
ULTRA THIN, WATERPROOF, EASY TO MOUNT LINEAR AND ANGULAR POSITION SENSORS

IN A
NUTSHELL

SPACE SAVING



Thickness of about **0.5 mm**



WATERPROOF



Totally **sealed**

IP66

EASY TO MOUNT

High integration **capacity** by
adhesive layer
“**stick and play**”

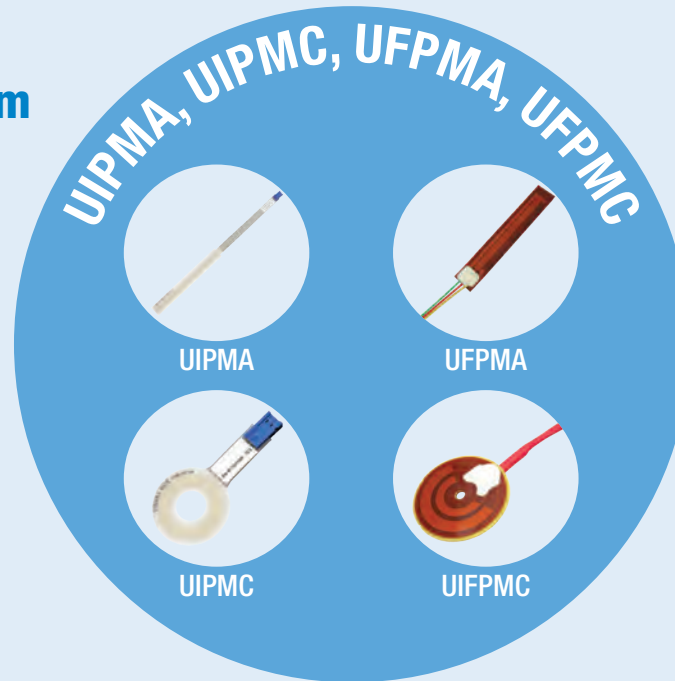


PROVEN RELIABILITY, HIGH DURABILITY

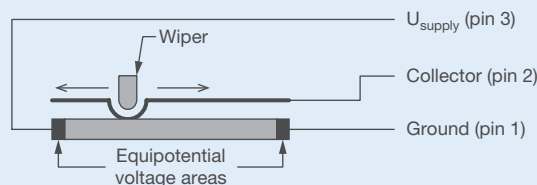


UIPMA **3 M** cycles

UFPMA **25 M** cycles



No direct contact of wiper so
no wearing of the track



APPLICATIONS



OFF-ROAD



MEDICAL



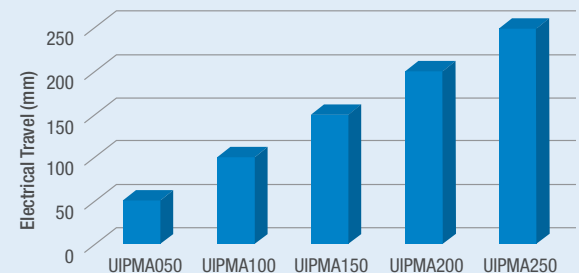
INDUSTRIAL

CUSTOMIZATION

- Output by leads or contacts
- Outdoor version
- Redundant functions
- Version to support pressure variations



PRODUCT PORTFOLIO



For Technical Questions: mcbprecisionpot@vishay.com

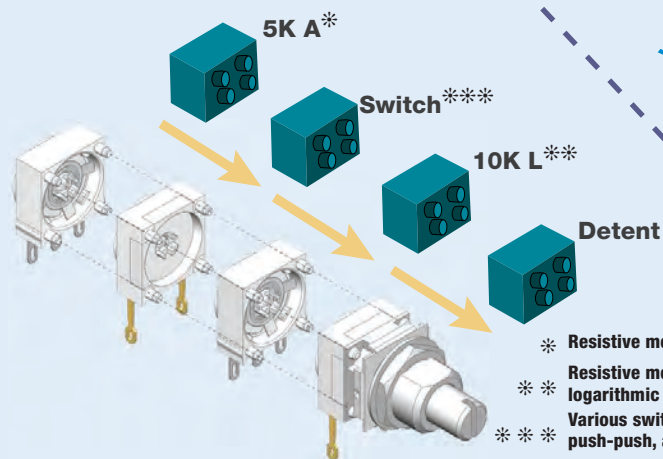
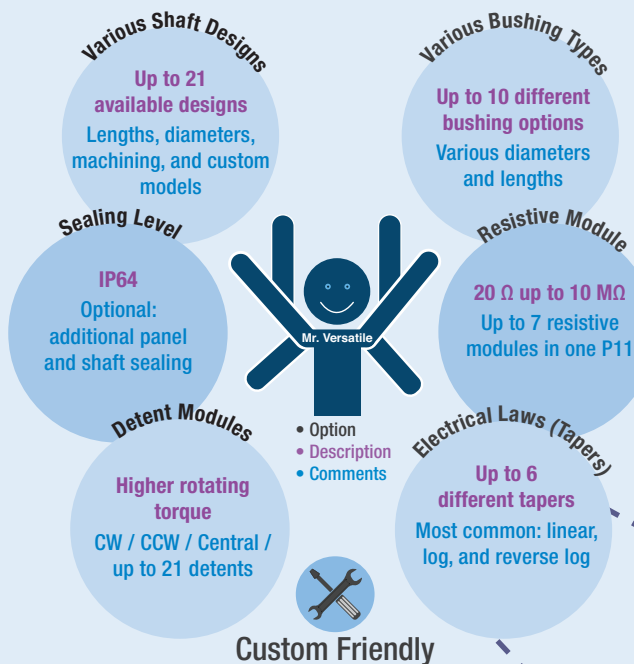


PANEL POTENTIOMETERS: MODEL P11

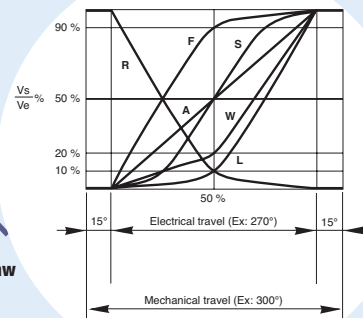
THE MOST VERSATILE MODULAR PANEL POTENTIOMETER

IN A NUTSHELL

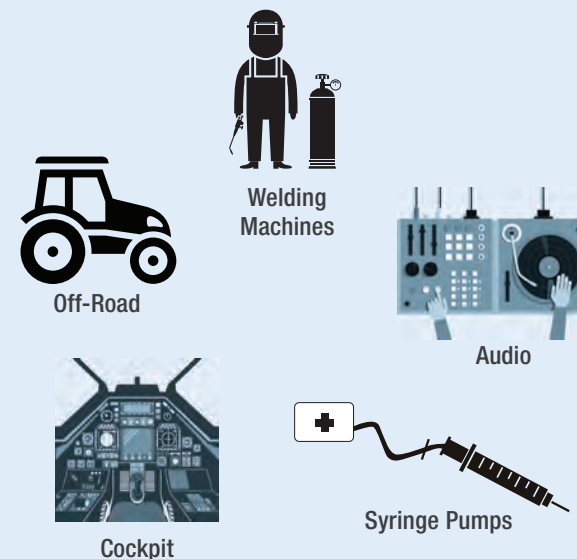
MODULAR PANEL POTENTIOMETER



Variation Curves



KEY APPLICATIONS



MULTIPLE MODELS

MODEL	SPECIFICITY	MARKETS
P11A*	Low noise and CRV	Audio
P11S & upon request	Genuine model	Avionics
	High torque	Heavy duty vibration
P11P	High dielectric strength	High voltages
P11L	Long life cycles	Heavy duty life
T11	No shaft, knob actuated	PCB mounting

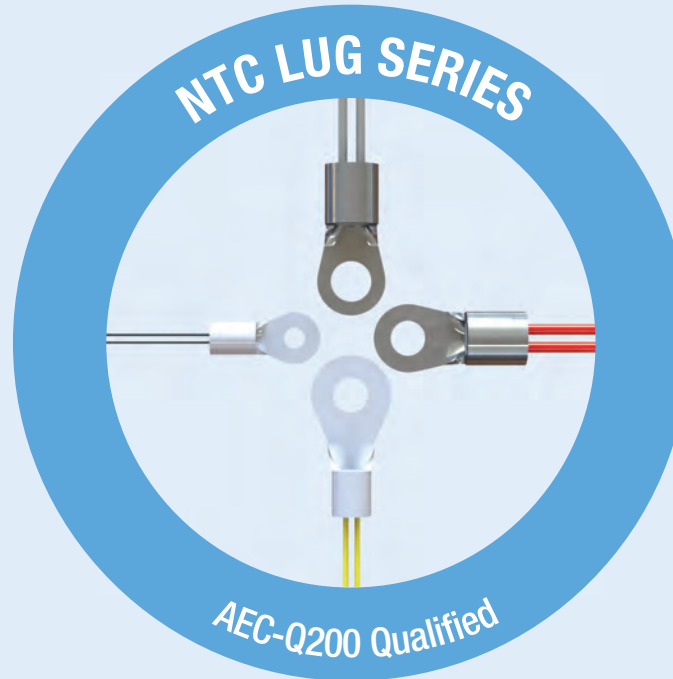
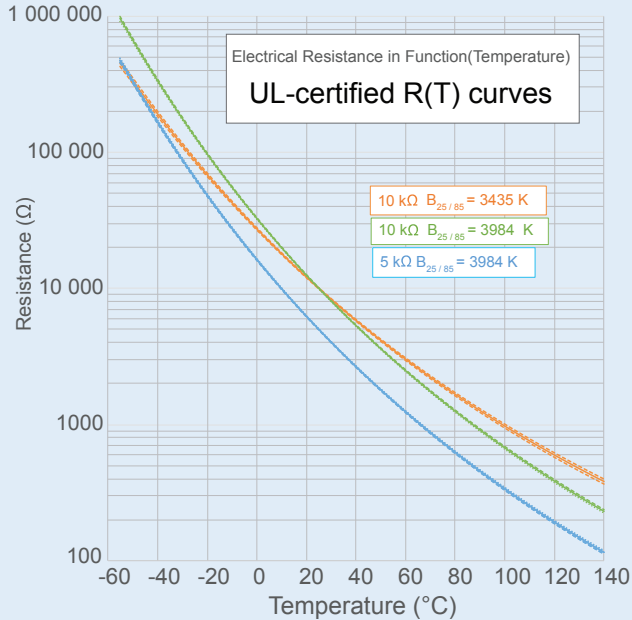
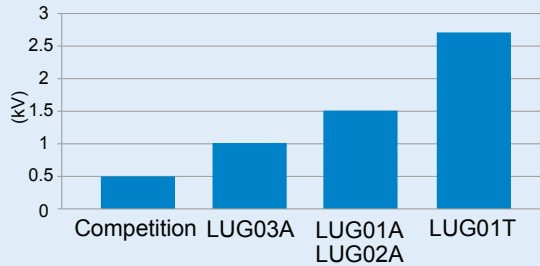


NTC LUG THERMISTORS

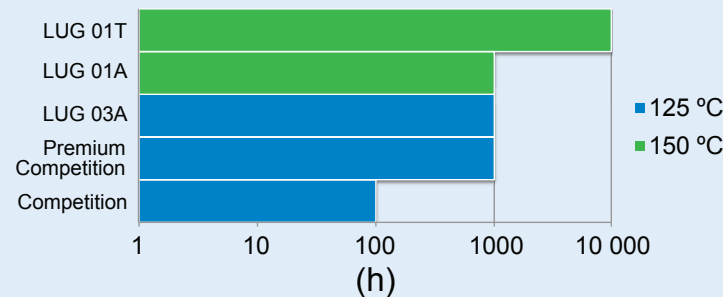
SURFACE TEMPERATURE SENSORS

IN A
NUTSHELL

HIGH INSULATION VOLTAGE FOR
EV HIGH POWER INVERTERS



RELIABLE OPERATING TEMP. OVER TIME



EASY MOUNTING
MECHANICAL OPTIONS

Mounting screw →							
Metric screw →	M2	M3	M3,5	M4	M5	M6	M8
Stud screw →	#1-2	#3-4	#5-6	#8	#10	#1/4	#5/16
CABLE AWG24							
CABLE AWG26							
CABLE AWG28							
CABLE AWG30							
CABLE AWG32							

KEY APPLICATIONS IN
AUTOMOTIVE / INDUSTRIAL

- Inverters
- DC/DC Converters
- Battery Management
- On-Board Chargers
- Charging Plugs
- Robotics

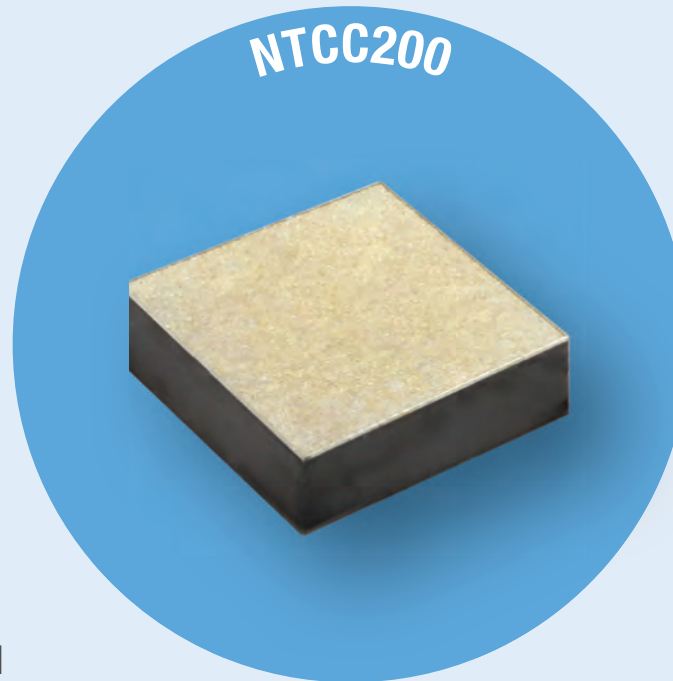
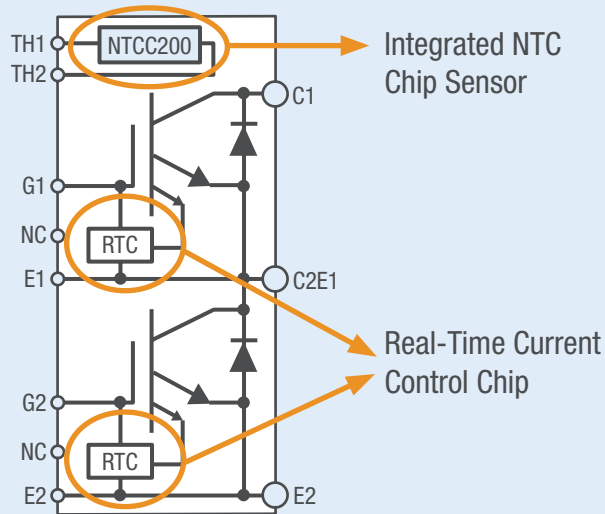
For Technical Questions: NLR@vishay.com



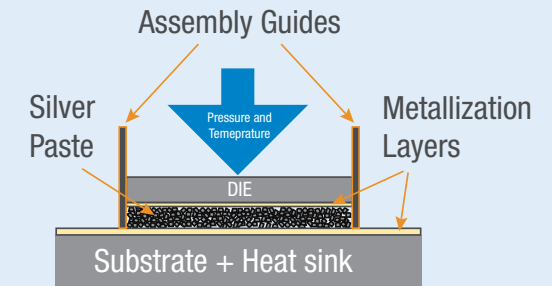
WIRE BONDABLE NTC THERMISTOR DIE

IN A NUTSHELL

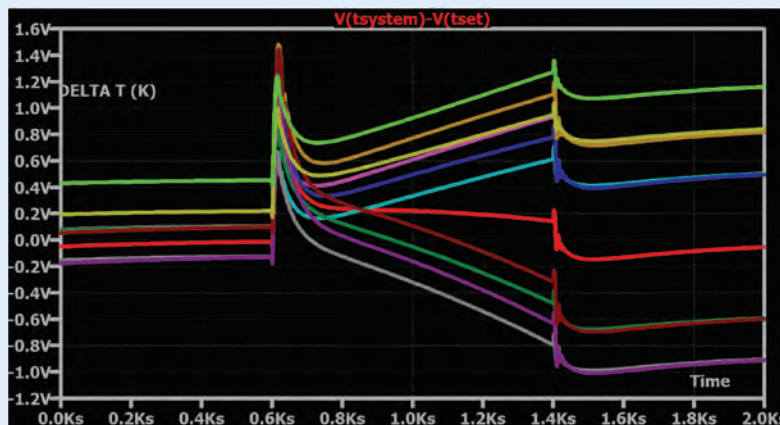
DESIGNED FOR IGBT MODULES



SUITABLE FOR WIRE BONDING AND NANO-SILVER PASTE SINTERING



TEMPERATURE SENSING AND REGULATION



INDUSTRIES

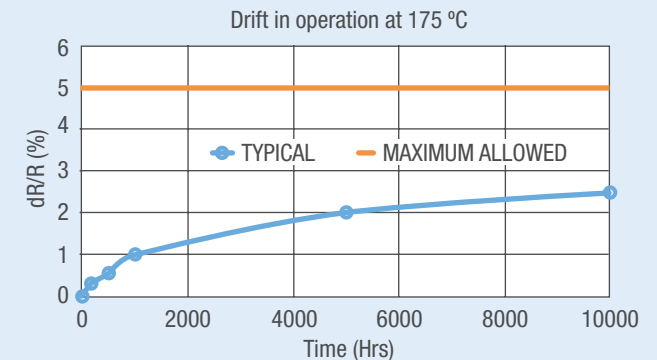


Power modules for EVs and hybrid vehicles



Inverters for windmills and solar panels

ACCURATE / STABLE AT HIGH TEMPERATURE (175 °C)



For Technical Questions: nlr@vishay.com



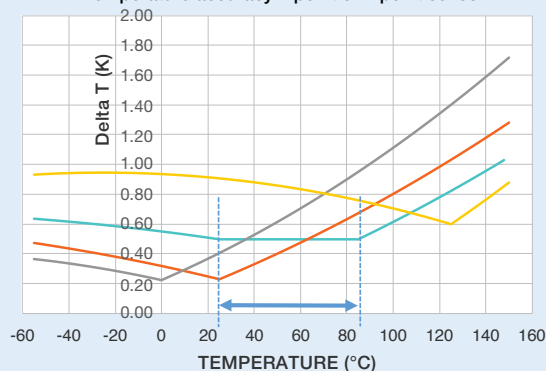
NTCLE LEADED-EPOXY COATED NTC THERMISTORS

RADIAL LEADS-SAWING TECHNOLOGY

IN A NUTSHELL

ACCURACY IN TEMPERATURE MEASUREMENT

Temperature accuracy 1 point or 2 point sensor



TEMPERATURE SENSING / CONTROL / PROTECTION

NTCLE203...SB0 10 K Ω



MULTIPLE DESIGN TOOLS AVAILABLE

- Resistance /temperature curve in “My Vishay NTC Curve” (©Excel)
- 3D models available (online)
- LT and PSpice models (online)
- SPICE multi-simulator models on request (adapted to most other SPICE simulators like Multisim / TINA...)

COMPONENTS AVAILABLE IN DIFFERENT WIRE GAGES, LENGTHS, WITH(OUT) INSULATION

Insulator	None	ETFE	PEEK	PTFE	PVC
Wire gage					
AWG32		Ag-plated Ni or NiFe			
AWG30	Sn-plated Ni	Sn-plated Ni	Ag-plated Ni	Ag-plated Ni	Sn-plated Cu
AWG28	Sn-plated Ni	Sn-plated Cu		Ag-plated Cu	
AWG26	Sn-plated Ni	Sn-plated Cu		Ag-plated Cu	
AWG24	Sn-plated Ni				Sn-plated Cu
AWG23	Sn-plated Cu				

Monostranded length 0.4 in up to 2 in
 Monostranded length 1.5 in up to 9 in

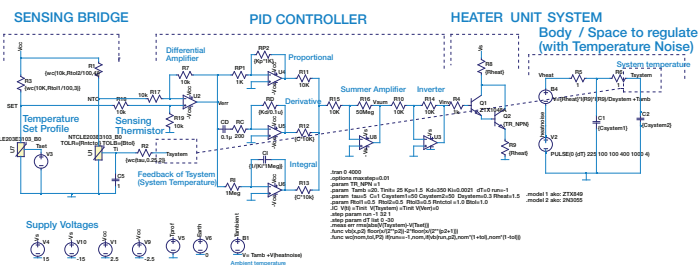
Multistranded length 1.5 in up to 9 in
 Multistranded length 2 in up to 150 in

APPLICATIONS

- EV battery sensor
- Charging plug
- Ambient thermostats
- Fire detectors
- Inlet Air Temp (IAT)
- Engine Coolant (ECT)
- Air conditioning



PID Temperature Controller With NTC Thermistor (Temperature / Voltage Driven)



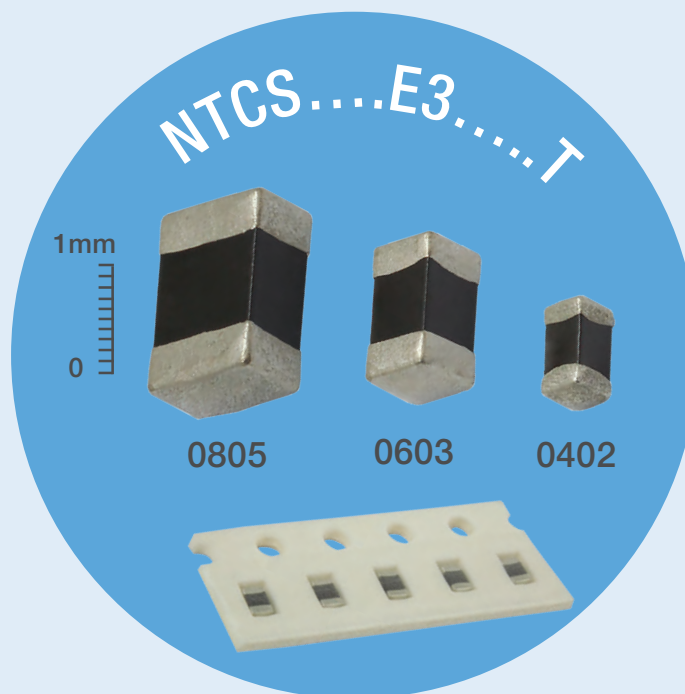
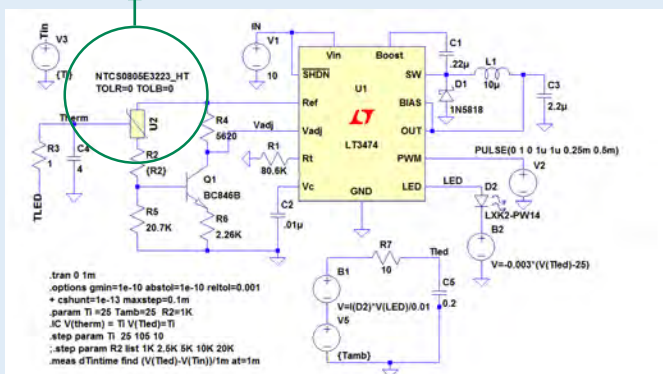
For Technical Questions: thermistor1@vishay.com

COMPLIANCE TO STANDARDS

- AEC-Q200 qualified
- Sustaining ESD air discharge: 25 kV (HBM)
- UL 1434 certified (File E148885)
- Sulfur-resistant to ASTM B809-95
- RoHS-compliant
- Whisker testing according to JESD 201 A

TEMPERATURE SENSING / CONTROL / PROTECTION

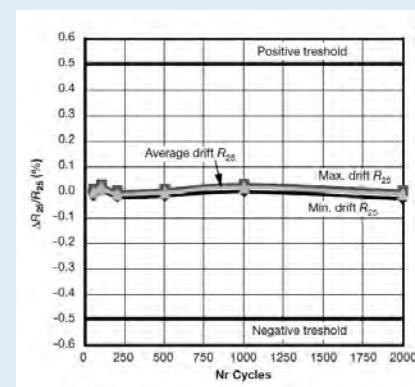
NTCS0805



MULTIPLE DESIGN TOOLS AVAILABLE

- Resistance / temperature curve in “My Vishay NTC Curve” (©Excel)
- Resistor / thermistor network output computation (online)
- SPICE multi-simulator models (PSpice / LTspice / TINA / Multisim / Altium / Simetrix / SaberRD...)

(VERY) STABLE IN
CLIMATIC TESTING
(OPERATIONAL LIFE)



APPLICATIONS

- LED over-current limitation
- Li-ion and Li-polymer over-temperature detection
- Power modules (EV, HEV, ...)
- Optoelectronics
- Car infotainment
- Medical equipment



FRED PT[®] RECTIFIERS IN eSMP[®] SERIES

SPACE-SAVING FOOTPRINTS AND LOW PROFILE PACKAGE SOLUTIONS FOR ALL MAJOR APPLICATIONS

IN A NUTSHELL

FRED Pt[®] (Fast Recovery Epitaxial Diodes) products are based on a Pt doping technology that allows **maximum operating junction temperature**

Up to 175 °C



Current range from 1 A to 30 A

Reverse voltage:
100 V, 200 V, and 600 V



Fast and soft recovery characteristics

Low leakage currents

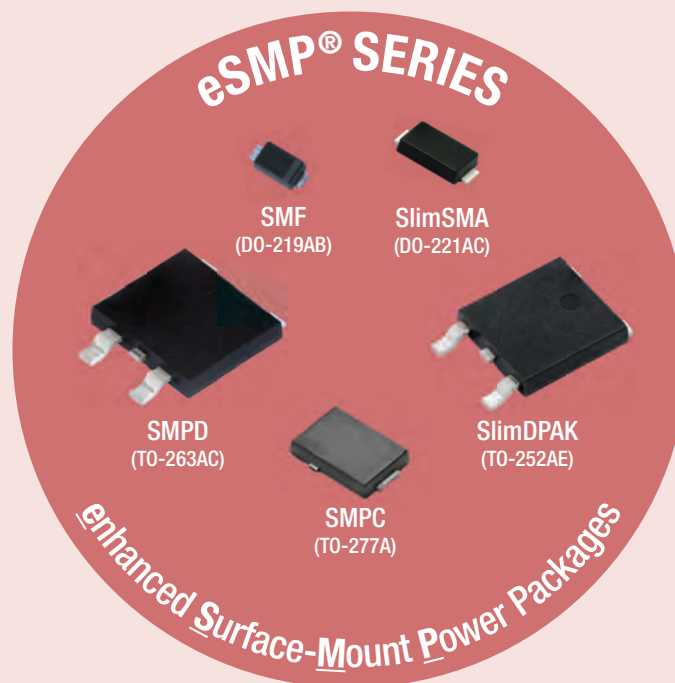


Low forward voltage drop

Reduce switching losses



eSMP[®] Series
Packages Overview



APPLICATIONS



DC/DC CONVERTERS



AUTOMOTIVE



POWER FACTOR
CORRECTION



TELECOM

FRED Pt[®] rectifiers available in the following packages:

- Standard Products
 - SlimDPAK (TO-252AE)
 - SlimSMA (DO-221AC)
 - SMF (DO-219AB)
 - SMPC (TO-277A)
 - SMPD (TO-263AC)
- AEC-Q101 Qualified Products
 - SlimDPAK (TO-252AE)
 - SlimSMA (DO-221AC)
 - SMF (DO-219AB)
 - SMPC (TO-277A)
 - SMPD (TO-213AC)

FRED Pt[®] **AEC-Q101 qualified** products have undergone **part average testing (PAT)** and **statistical yield limit (SYL)** analysis to ensure their electrical parameters meet the **highest quality** level for **automotive** applications



**AEC-Q101
Qualified**



FRED Pt[®] RECTIFIERS IN SlimDPAK PACKAGE


INCREASE POWER DENSITY AND IMPROVE THERMAL PERFORMANCE

IN A NUTSHELL

Reverse voltages: 200 V and 600 V 



Ultrafast recovery times down to 14 ns

Low forward drop reduces power losses and improves efficiency 



Footprint compatible with DPAK with 43 % lower profile for slimmer end products, while heatsink area is 14 % larger for lower thermal resistance



and Commercial / Industrial Versions Available

SlimDPAK (TO-252AE) PACKAGE



9.0 mm x 6.2 mm x 1.3 mm
(L x W x H)

FRED Pt[®] (Fast Recovery Epitaxial Diodes) products are based on a Pt doping technology that allows **maximum operating junction temperature**

Up to 175 °C 



APPLICATIONS



AUTOMOTIVE
ECU, ABS, and
HID / LED lighting



COMMERCIAL / INDUSTRIAL
Telecom power supplies



DC/DC CONVERTERS

Vishay P/N	I _{FAV} (A)	V _{BR} (V)	V _F (V)	at I _F (A)	t _{rr} (ns)	I _{FSM} (A)	T _J max. (°C)	AEC-Q101 Available
VS-4EVH02HM3	4	200	0.71	4	16	100	175	Yes
VS-4EVH02-M3	4	200	0.71	4	16	100	175	No
VS-6CVH02HM3	2 x 3	200	0.75	3	20	140	175	Yes
VS-6CVH02-M3	2 x 3	200	0.75	3	16	100	175	No
VS-8CVH02HM3	2 x 4	200	0.71	4	16	200	175	Yes
VS-8CVH02-M3	2 x 4	200	0.71	4	16	200	175	No
VS-10CVH02HM3	2 x 5	200	0.74	5	16	200	175	Yes
VS-10CVH02-M3	2 x 5	200	0.74	5	16	200	175	No
VS-6EVL06HM3	6	600	0.98	6	34	80	175	Yes
VS-6EVL06-M3	6	600	0.98	6	34	80	175	No
VS-6EVH06HM3	6	600	1.26	6	16	70	175	Yes
VS-6EVH06-M3	6	600	1.26	6	16	70	175	No
VS-6EVX06HM3	6	600	1.65	6	14	50	175	Yes

Vishay P/N	I _{FAV} (A)	V _{BR} (V)	V _F (V)	at I _F (A)	t _{rr} (ns)	I _{FSM} (A)	T _J max. (°C)	AEC-Q101 Available
VS-6EVX06-M3	6	600	1.65	6	14	50	175	No
VS-8EVL06HM3	8	600	0.98	8	34	130	175	Yes
VS-8EVL06-M3	8	600	0.98	8	34	130	175	No
VS-8EVH06HM3	8	600	1.30	8	16	90	175	Yes
VS-8EVH06-M3	8	600	1.30	8	16	90	175	No
VS-8EVX06HM3	8	600	1.40	8	14	80	175	Yes
VS-8EVX06-M3	8	600	1.40	8	14	80	175	No
VS-15EVL06HM3	15	600	0.98	15	38	180	175	Yes
VS-15EVL06-M3	15	600	0.98	15	38	180	175	No
VS-15EVU06HM3	15	600	1.10	15	26	160	175	Yes
VS-15EVU06-M3	15	600	1.10	15	26	160	175	No
VS-15EVH06HM3	15	600	1.20	15	20	120	175	Yes
VS-15EVH06-M3	15	600	1.20	15	20	120	175	No

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com



FRED Pt[®] RECTIFIERS IN SMPD (TO-263AC)

OFFER HIGHER POWER DENSITY

IN A NUTSHELL

FEATURES

- Hyperfast and ultrafast recovery
- Fast and soft recovery (down to 25 ns)
- Low forward voltage drop (down to 0.75 V typ.)
- AEC-Q101 qualified

REDUCED POWER LOSSES



Reduced noise



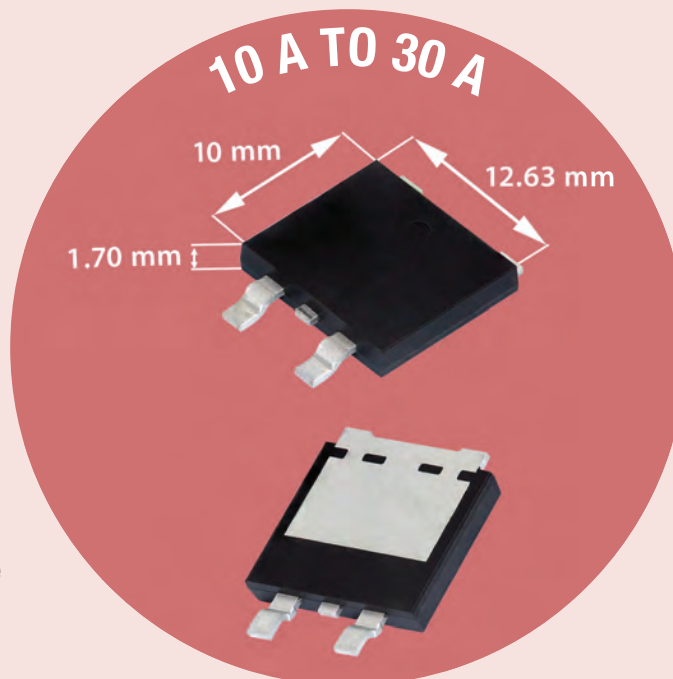
Reduced EMI

MORE EFFICIENT DESIGNS

FRED Pt[®] technology allows high operating temperatures to +175 °C

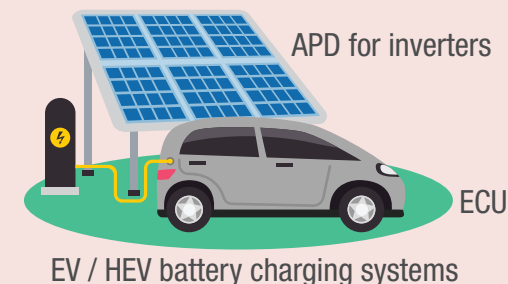


+175 °C
operating temperature



APPLICATIONS

AUTOMOTIVE and INDUSTRIAL



SMPD package is compatible with D²PAK footprint but with lower profile

SMPD $h > 1.70 \text{ mm}$

D²PAK $h = 4.45 \text{ mm}$

Vishay P/N	Type	Diode Variation	I _{F(AV)} (A)	V _R (V)	V _F Typ at Rated I (V)	T _{rr} Typ (ns)	AEC-Q101
VS-10CDH06-M3	Hyperfast	Dual	2 x 5	600	1	35	No
VS-10CDH06HM3	Hyperfast	Dual	2 x 5	600	1	35	Yes
VS-12CDU06-M3	Ultrafast	Dual	2 x 6	600	0.89	45	No
VS-12CDU06HM3	Ultrafast	Dual	2 x 6	600	0.89	45	Yes
VS-16CDH02-M3	Hyperfast	Dual	2 x 8	200	0.77	27	No
VS-16CDH02HM3	Hyperfast	Dual	2 x 8	200	0.77	27	Yes
VS-16CDU06-M3	Ultrafast	Dual	2 x 8	600	0.94	45	No
VS-16CDU06HM3	Ultrafast	Dual	2 x 8	600	0.94	45	Yes

Vishay P/N	Type	Diode Variation	I _{F(AV)} (A)	V _R (V)	V _F Typ at Rated I (V)	T _{rr} Typ (ns)	AEC-Q101
VS-16EDH02-M3	Hyperfast	Single	16	200	0.75	32	No
VS-16EDH02HM3	Hyperfast	Single	16	200	0.75	32	Yes
VS-16EDU06-M3	Ultrafast	Single	16	600	0.91	55	No
VS-16EDU06HM3	Ultrafast	Single	16	600	0.91	55	Yes
VS-20CDH02-M3	Hyperfast	Dual	2 x 10	200	0.77	25	No
VS-20CDH02HM3	Hyperfast	Dual	2 x 10	200	0.77	25	Yes
VS-30CDU06-M3	Ultrafast	Dual	2 x 15	600	0.9	55	No
VS-30CDU06HM3	Ultrafast	Dual	2 x 15	600	0.9	55	Yes

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com

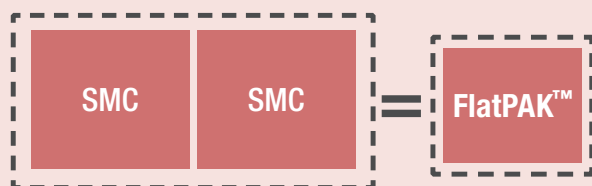


FRED Pt[®] ULTRAFAST RECTIFIERS IN FLATPAK[™] 5 X 6

IN A NUTSHELL

INCREASE POWER DENSITY AND PERFORMANCE EFFICIENCY

Simplify PCB layouts with
ONE PACKAGE INSTEAD OF TWO;
SAVING > 65 % PCB SPACE



200 V reverse voltage



Low forward drop reduces power losses and improves efficiency



High forward current ratings of
6 A (2 x 3 A) and 8 A (2 x 4 A)

Ultrafast recovery times down to 25 ns

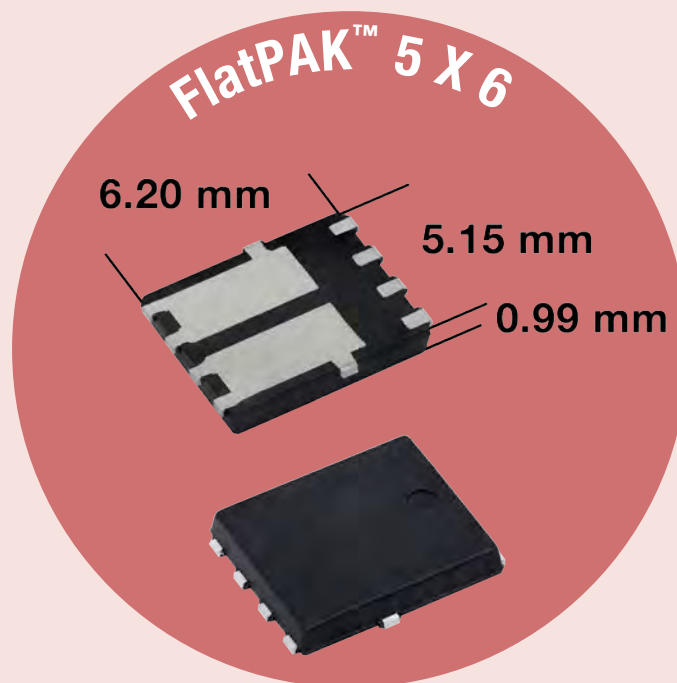


2000 hours of high temperature
reverse bias (HTRB) testing
guarantees long term reliability



Operating temperature range of

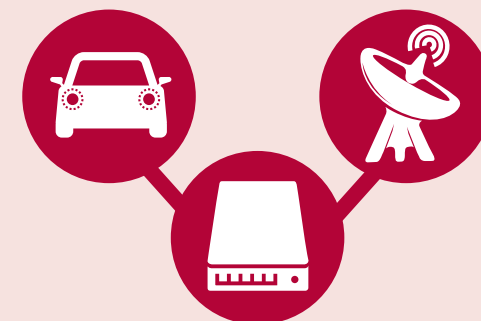
-55 °C to +175 °C





APPLICATIONS

DC/DC converters

- AEC-Q101 rectifiers: automotive engine control units (ECU), anti-lock braking systems (ABS), and HID and LED lighting
- Commercial / industrial rectifiers: telecom power supplies



Vishay P/N	Forward Current $I_{F(AV)}$	Forward Voltage V_F at I_F	Reverse Recovery Time t_{rr}	AEC-Q101
VS-6DKH02-M3	2 x 3 A	0.71 V	25 ns	No
VS-6DKH02HM3 	2 x 3 A	0.71 V	25 ns	Yes
VS-8DKH02-M3	2 x 4 A	0.7 V	25 ns	No
VS-8DKH02HM3 	2 x 4 A	0.7 V	25 ns	Yes

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com



TMBS[®] RECTIFIERS IN eSMP[®] SERIES

TRENCH MOS BARRIER SCHOTTKY TECHNOLOGY IN SPACE-SAVING FOOTPRINTS AND LOW PROFILE PACKAGE SOLUTIONS

IN A NUTSHELL



Reverse voltage from 45 V to 200 V

Current range from 1 A to 60 A



Low profile package heights

Low power losses and high efficiency



Trench MOS Schottky technology provides low forward voltage drop



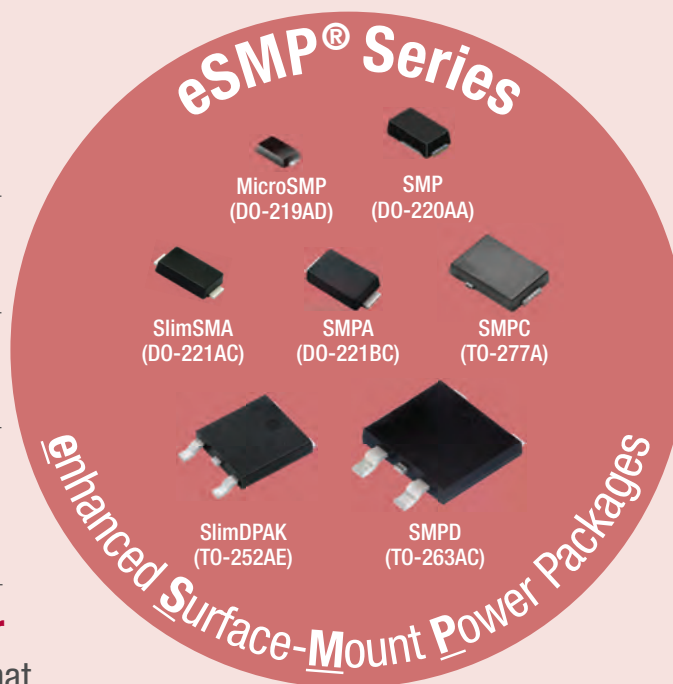
Enable **higher current** and **power efficiency** with a **unique design** that promotes better **thermal performance** and **reliability**



MAXIMUM OPERATING JUNCTION TEMPERATURE

Up to 175 °C

For M type Schottky barrier part numbers



APPLICATIONS



DC/DC CONVERTERS
FREE-WHEELING



CONSUMER



AUTOMOTIVE



INDUSTRIAL

Select **TMBS[®]** rectifiers available in the following packages:

- MicroSMP (DO-219AD)
- SlimDPAK (TO-252AE)
- SlimSMA (DO-221AC)
- SMP (DO-220AA)
- SMPA (DO-221BC)
- SMPC (TO-277A)
- SMPD (TO-263AC)

AEC-Q101
Qualified



TMBS[®] **AEC-Q101** qualified products have undergone **part average testing (PAT)** and **statistical yield limit (SYL)** analysis to ensure their electrical parameters meet the **highest quality** level for **automotive** applications



AEC-Q101
Qualified

eSMP[®] Series
Packages Overview





eSMP® SERIES

SMALL AND LOW PROFILE PACKAGE SOLUTIONS
FOR SELECT DIODES AND RECTIFIERS

IN A
NUTSHELL

eSMP® Packages

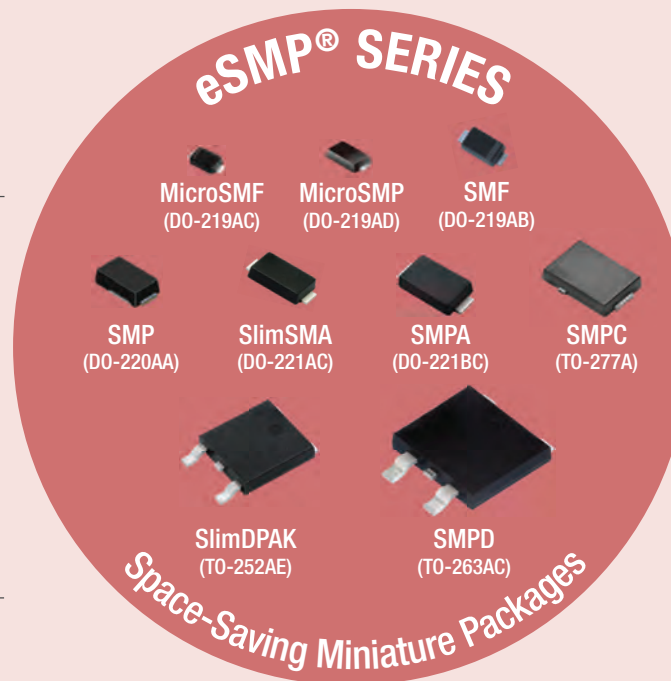
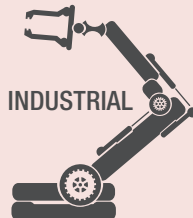
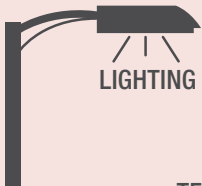
enhanced **S**urface-**M**ount **P**ower packages



Enable **higher current**
and **power efficiency**
with a **unique design**
that **promotes better**
thermal performance
and **reliability**



APPLICATIONS



USEFUL LINKS

eSMP® series product overview:

www.vishay.com/doc?49383

Diodes / rectifiers in eSMP® series package:

www.vishay.com/landingpage/tradeshows/diodes/

Product technologies available
in **eSMP®** series packages:

- ESD protection diodes
- PAR® TVS diodes
- TRANSZORB® TVS diodes
- Zener diodes
- Avalanche rectifiers
- FRED Pt® rectifiers
- Schottky rectifiers
- Standard and fast recovery rectifiers
- TMBS® rectifiers
- Ultrafast recovery rectifiers

Available in **asymmetrical** and
symmetrical flat type packages



STANDARD RECOVERY RECTIFIERS

ESD CAPABILITY

IN A NUTSHELL

- Oxide planar chip technology
- ESD capability
 - Provide class H3B (> 8 kV) performance based on the AEC-Q101-001 human body model (contact mode) and / or JESD22-A114, class 3B



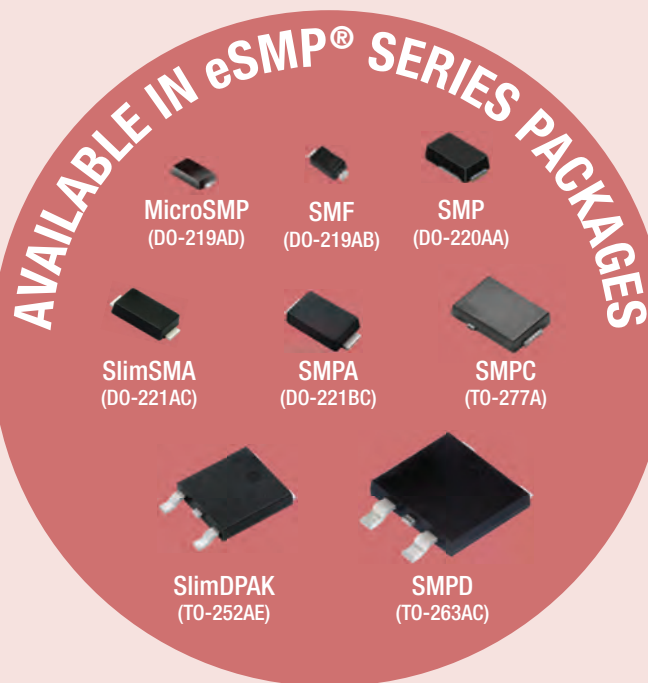
Electrical Static Discharge (ESD)



Current range from 0.7 A to 20 A



Reverse voltage from 100 V to 600 V



APPLICATIONS



- General purpose
- Polarity protection
- Rail to rail protection



CONSUMER

Maximum operating junction temperature of +175 °C



Low forward voltage drop, low leakage current

AEC-Q101 qualified products have undergone **part average testing (PAT)** and **statistical yield limit (SYL)** analysis to ensure their electrical parameters meet the **highest quality** level for **automotive** applications



AEC-Q101 Qualified

Device ⁽¹⁾	eSMP® Package	I _{F(AV)} (A)	V _{BR} Range (V)	Max V _F at I _F (V)	(A)	AEC-Q101	Automotive Grade
SE07PB thru SE07PJ	SMP (DO-220AA)	0.7	100 to 600	1.05	0.7	No	No
MSE07PB thru MSE07PJ	MicroSMP (DO-219AD)	0.7	100 to 600	1.08	0.7	Yes	Yes
SE10PB thru SE10PJ	SMP (DO-220AA)	1.0	100 to 600	1.05	1.0	Yes	Yes
MSE1PB thru MSE1PJ	MicroSMP (DO-219AD)	1.0	100 to 600	1.10	1.0	Yes	Yes
MSX1PB thru MSX1PJ	MicroSMP (DO-219AD)	1.0	100 to 600	1.10	1.0	Yes	Yes
SE10FD thru SE10FJ	SMF (DO-219AB)	1.0	200 to 600	1.05	1.0	Yes	Yes
SE15PB thru SE15PJ	SMP (DO-220AA)	1.5	100 to 600	1.05	1.5	Yes	Yes
SE15FD thru SE15FJ	SMF (DO-219AB)	1.5	200 to 600	1.05	1.0	Yes	Yes
SE20PB thru SE20PJ	SMP (DO-220AA)	2.0	100 to 600	1.05	2.0	Yes	Yes
SE20FD thru SE20FJ	SMF (DO-219AB)	2.0	200 to 600	1.10	2.0	Yes	Yes
SE20AFB thru SE20AFJ	SlimSMA (DO-221AC)	2.0	100 to 600	1.10	2.0	Yes	No

(1) Reverse voltage, where: A = 50 V, B = 100 V, C = 150 V, D = 200 V, F = 300 V, G = 400 V, H = 500 V, J = 600 V

Device ⁽¹⁾	eSMP® Package	I _{F(AV)} (A)	V _{BR} Range (V)	Max V _F at I _F (V)	(A)	AEC-Q101	Automotive Grade
SE20PAB thru SE20PAJ	SMPA (DO-221BC)	2.0	100 to 600	1.10	2.0	Yes	No
SE30AFB thru SE30AFJ	SlimSMA (DO-221AC)	3.0	100 to 600	1.10	3.0	Yes	No
SE30PAB thru SE30PAJ	SMPA (DO-221BC)	3.0	100 to 600	1.16	3.0	Yes	No
SE40PB thru SE40PJ	SMPC (TO-277A)	4.0	100 to 600	1.05	4.0	Yes	Yes
SE50PAB thru SE50PAJ	SMPA (DO-221BC)	5.0	100 to 600	1.16	5.0	Yes	No
SE60PWB thru SE60PWJ	SlimDPAK (TO252AE)	2 x 3	100 - 600	1.10	3.0	Yes	No
SE70PB thru SE70PJ	SMPC (TO-277A)	7.0	100 to 600	1.05	7.0	Yes	Yes
SE80PWB thru SE80PWJ	SlimDPAK (TO252AE)	8.0	100 to 600	1.12	8	Yes	No
SE10DB thru SE10DJ	SMPD (TO-263AC)	10	100 to 600	1.15	10	Yes	No
SE100PWB thru SE100PWJ	SlimDPAK (TO252AE)	10	100 to 600	1.14	10	Yes	No
SE12DB thru SE12DJ	SMPD (TO-263AC)	12	100 to 600	1.15	12	Yes	No
SE20DB thru SE20DJ	SMPD (TO-263AC)	20	100 to 600	1.20	20	Yes	No

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com



TRANSZORB® TVS IN SMB (DO-214AA)

OFFER TIGHTER $\pm 3.5\%$ BREAKDOWN VOLTAGE TOLERANCE

IN A NUTSHELL

FEATURES

$\pm 3.5\%$ Tightened breakdown voltage tolerance of $\pm 3.5\%$

High peak pulse surge currents from 2.03 A to 65.9 A

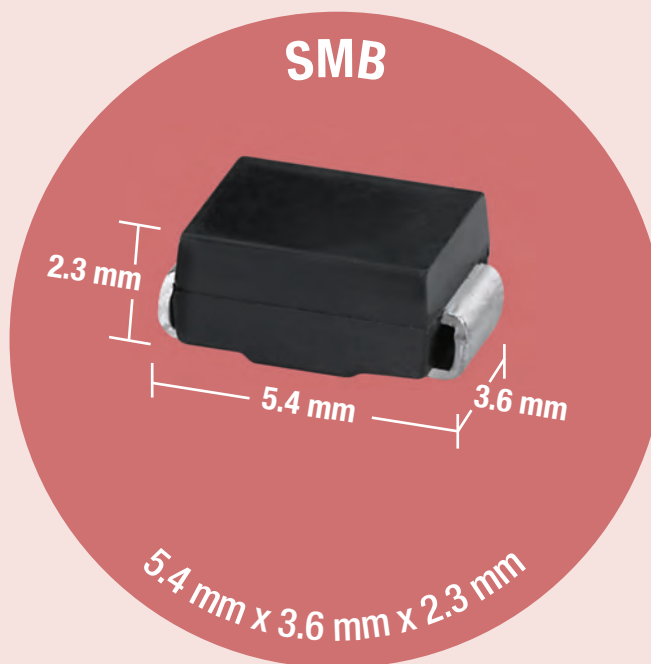


9.1 V to 301 V Excellent clamping capability from 9.1 V to 301 V

High surge capability to 600 W at 10/1000 μ s



Available with unidirectional or bidirectional polarity

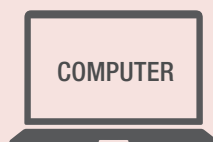


APPLICATIONS



Designed to **protect** sensitive electronics against **voltage transients** induced by inductive load switching and lightning

General voltage surge protection in **consumer, computer, industrial, and telecommunications** equipment



TELECOM



CONSUMER



INDUSTRIAL

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Device Type	Breakdown Voltage V_{BR} at $I_T^{(1)}$ (V)		Test Current I_T (A)	Stand-Off Voltage V_{WM} (V)	Max Reverse Leakage at V_{WM} I_{R0} (μ A) ⁽²⁾	Max Peak Pulse Surge Current I_{PPM} (A) ⁽³⁾	Max Clamping Voltage at I_{PPM} V_C (V)
	min	max					
SMBJ5.0D*	6.50	6.97	10	5.0	500	65.9	9.1
SMBJ6.0D*	6.77	7.27	10	6.0	500	58.9	10.2
SMBJ6.5D*	7.33	7.87	10	6.5	300	54.5	11.0
SMBJ7.0D*	7.90	8.48	10	7.0	150	50.8	11.8
SMBJ7.5D*	8.46	9.08	1.0	7.5	75	47.2	12.7
SMBJ8.0D*	9.03	9.69	1.0	8.0	35	44.8	13.4
SMBJ8.5D*	9.57	10.3	1.0	8.5	15	42.2	14.3
SMBJ9.0D*	10.2	10.9	1.0	9.0	5.0	39.7	15.1
SMBJ10D*	11.3	12.1	1.0	10	2.0	35.9	16.7
SMBJ11D*	12.4	13.3	1.0	11	2.0	33.5	17.9
SMBJ12D*	13.5	14.5	1.0	12	2.0	30.6	19.6
SMBJ13D*	14.6	15.7	1.0	13	0.5	28.3	21.2
SMBJ14D*	15.8	17.0	1.0	14	0.5	26.2	22.9
SMBJ15D*	17.0	18.2	1.0	15	0.5	25.0	24.0
SMBJ16D*	18.1	19.4	1.0	16	0.5	23.4	25.6
SMBJ17D*	19.2	20.6	1.0	17	0.5	22.1	27.2
SMBJ18D*	20.3	21.8	1.0	18	0.5	20.8	28.8
SMBJ20D*	22.5	24.2	1.0	20	0.5	18.8	32.0
SMBJ22D*	24.8	26.6	1.0	22	0.5	17.1	35.1
SMBJ24D*	27.1	29.1	1.0	24	0.5	15.6	38.4
SMBJ26D*	29.3	31.5	1.0	26	0.5	14.5	41.6
SMBJ28D*	31.6	33.9	1.0	28	0.5	13.4	44.7
SMBJ30D*	33.8	36.3	1.0	30	0.5	12.6	47.7
SMBJ33D*	37.3	40.0	1.0	33	0.5	11.5	52.5
SMBJ36D*	40.6	43.6	1.0	36	0.5	10.5	57.3
SMBJ40D*	45.1	48.4	1.0	40	0.5	9.43	63.6
SMBJ43D*	48.5	52.1	1.0	43	0.5	8.76	68.5
SMBJ45D*	50.8	54.5	1.0	45	0.5	8.40	71.6
SMBJ48D*	54.1	58.1	1.0	48	0.5	7.90	76.3
SMBJ51D*	57.6	61.8	1.0	51	0.5	7.40	81.2
SMBJ54D*	60.9	65.4	1.0	54	0.5	7.00	85.9
SMBJ58D*	65.4	70.2	1.0	58	0.5	6.50	92.3
SMBJ60D*	67.7	72.7	1.0	60	0.5	6.28	95.5
SMBJ64D*	72.2	77.5	1.0	64	0.5	5.88	102
SMBJ70D*	79.0	84.8	1.0	70	0.5	5.40	111
SMBJ75D*	84.6	90.8	1.0	75	0.5	5.06	119
SMBJ78D*	88.1	94.4	1.0	78	0.5	4.86	124
SMBJ85D*	95.7	103	1.0	85	0.5	4.46	135
SMBJ90D*	102	109	1.0	90	0.5	4.17	144
SMBJ100D*	113	121	1.0	100	0.5	3.77	159
SMBJ110D*	124	133	1.0	110	0.5	3.45	174
SMBJ120D*	135	145	1.0	120	0.5	3.15	190
SMBJ130D*	146	157	1.0	130	0.5	2.94	206
SMBJ150D*	170	182	1.0	150	0.5	2.53	239
SMBJ160D*	181	194	1.0	160	0.5	2.34	256
SMBJ170D*	192	206	1.0	170	0.5	2.23	270
SMBJ188D	212	228	1.0	188	0.5	2.03	301

To view datasheet, click here

Notes:

* All terms and symbols are consistent with ANSI/IEEE C62.35

(1) Pulse test: $t_1 < 50$ ms

(2) For bi-directional types having V_{WM} of 12 V and less, the ID limit is doubled

(3) Surge current waveform per fig. 3 and derate per fig. 2

* Underwriters Laboratory Recognition for the classification of protectors (QVQ2) under the UL standard for safety 497B and file number E136766 for both uni-directional and bi-directional device



VTVSXXGSMF SERIES

400 W TVS IN SMF (DO-219AB) PACKAGE



IN A NUTSHELL

High surge capability of 400 W
at 10/1000 μ s



Low profile (1 mm)
SMF (DO-219AB) package

HALOGEN
FREE

RoHS
COMPLIANT

AEC-Q101
Qualified

COMPETITIVE ADVANTAGE

- Low avalanche breakdown voltage tolerance allows tighter design of electronic circuits
- Lower avalanche breakdown voltage tolerance = lower clamping voltage tolerance



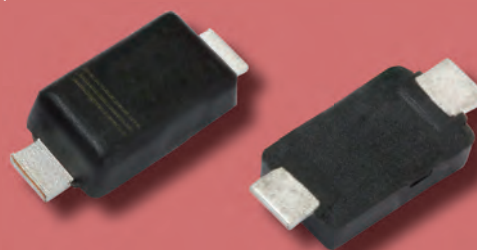
**AVALANCHE
BREAKDOWN
VOLTAGE
TOLERANCE**

=

**CLAMPING
VOLTAGE
TOLERANCE**

- Important when a transient voltage signal must be clamped close to the max. voltage range!

FIRST TO FEATURE ACCURATE 2% V_Z *



**Only parts with 5 % V_Z
(breakdown voltage tolerance)
offered by competitors*



Low leakage current

Low noise technology



Very fast response time

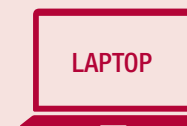
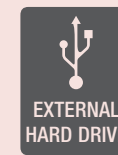
Precise protection for
key components



VTVS Series consists of 23 devices
([VTVS5V0ASMF](#) to [VTVS63GSMF](#))

APPLICATIONS

Ideal for space-constrained electronics



PRIMARY CHARACTERISTICS

V_{BR}	6.4 V to 78.2 V
V_{WM}	5.0 V to 63 V
P_{PPM}	400 W
T_J max.	175 °C
Polarity	Uni-directional
Package	DO-219AB (SMF)



TRANSIENT VOLTAGE SUPPRESSORS IN eSMP® SERIES PACKAGES

TRANSZORB® and PAR® TVS

SNAPSHOT



High temperature stability in high
reliability conditions to +185 °C



Low profile eSMP® packages:

MicroSMP (DO-219AD): 0.65 mm typical

SlimSMA (DO-221AC): 0.95 mm

SMF (DO-219AB): 1.0 mm

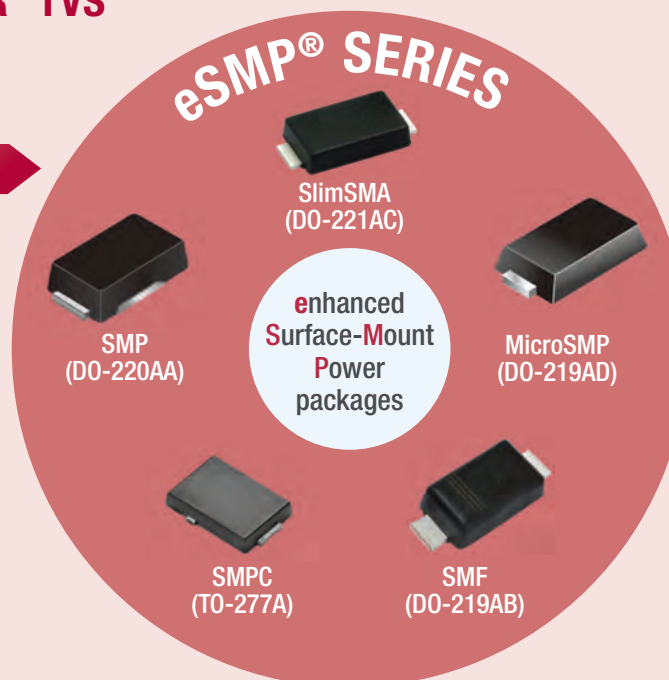
SMP (DO-220AA): 1.0 mm

SMPC (T0-277A): 1.1 mm typical

AEC-Q101 qualified and



Automotive Grade versions available



Applications

Protect sensitive electronics
against voltage transients



CONSUMER



COMPUTER



INDUSTRIAL



TELECOM



AUTOMOTIVE

TRANSZORB® TVS diodes are
recommended for general applications

#1

PAR® TVS diodes are the **first choice**
for automotive applications

Series	Package Outline	Power Rating (W)	TVS Polarity	V _{BR} Min. (V)	V _{WM} Min. (V)	V _{WM} Max. (V)	T _J Max. (°C)	Product Line
MSMP6.0A thru MSMP20A	MicroSMP (DO-219AD)	150	Unidirectional	6.67	6	20	150	TRANSZORB® TVS
MSP3V3, MSP5.0A	MicroSMP (DO-219AD)	150	Unidirectional	4.1	3.3	5	150	TransZorb® TVS
SMP3V3 thru SMP36A	SMP (DO-220AA)	400	Unidirectional	4.1	3.3	36	150	TransZorb® TVS
TPSMP6.8A thru TPSMP43A	SMP (DO-220AA)	400	Unidirectional	6.45	5.8	36.8	185	PAR® TVS
SMPC5.0A thru SMPC36A, SMPC22AN thru SMPC85AN	SMPC (T0-277A)	1500	Unidirectional	6.4	5	85	150	TransZorb® TVS
TPC11CA thru TPC36CA	SMPC (T0-277A)	1500	Bidirectional	10.5	9.4	30.8	185	PAR® TVS
TPC6.8A thru TPC51A	SMPC (T0-277A)	1500	Unidirectional	6.45	5.8	43.6	185	PAR® TVS
VTVS3V3ASMF to VTVS63GSMF	SMF (DO-219AB)	400	Unidirectional	6.4	3.3	63	175	TransZorb® TVS
SMA6F5.0A thru SMA6F20A	SlimSMA (DO-221AC)	600	Unidirectional	6.4	5	20	175	TransZorb® TVS
TA6F6.8A thru TA6F51A	SlimSMA (DO-221AC)	600	Unidirectional	6.45	5.8	43.6	185	PAR® TVS



ESD PROTECTION DIODES

IN ULTRA COMPACT CHIP LEVEL PACKAGE (CLP)

IN A NUTSHELL



Single-line and **4-line**
ESD protection diodes



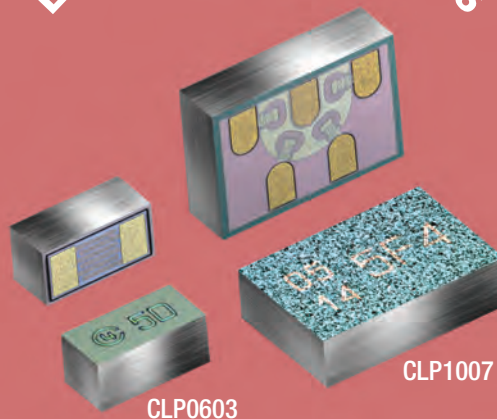
Working range:
 $\pm 3.3\text{ V}$ to $\pm 10\text{ V}$



Low leakage current:
 $< 0.1\text{ }\mu\text{A}$

AEC-Q101
Qualified versions **available**

ESD Protection Diodes



CLP Series

Operating **temperature** range:
 $-55\text{ }^{\circ}\text{C}$ to $+150\text{ }^{\circ}\text{C}$



APPLICATIONS

ESD protection of high speed interfaces in:



SMARTPHONES



DIGITAL CAMERAS



AUTOMOTIVE
ENTERTAINMENT
SYSTEMS



GAMING SYSTEMS

Vishay P/N	V_{RWM} (V)		I_R (μA)	C_D (PF)	Contact Discharge (KV)	Air Discharge (KV)	AEC-Q101 Available
	Unidirectional	Bidirectional					
VBUS03B1-SD0		± 3.3	< 0.05	0.29 typ.	± 16	± 16	Yes
VBUS05B1-SD0		± 5.5	< 0.05	0.29 typ.	± 16	± 16	Yes
VBUS54FD-SD1	± 5.5		< 0.1	0.9 typ.	± 15	± 15	No
VCUT03E1-SD0		± 3.3	< 0.1	< 14	± 30	± 30	Yes
VCUT05E1-SD0		± 5.5	< 0.1	< 14	± 30	± 30	Yes
VCUT10A1-SD0		± 10	< 0.1	< 9	± 24	± 24	Yes

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com



PLZ SERIES

ZENER DIODES IN MICROSMF (DO-219AC) PACKAGE

IN A NUTSHELL

500 mW power dissipation



Ultra compact MicroSMF (DO-219AC) flat lead package; **< 0.6 mm** low profile

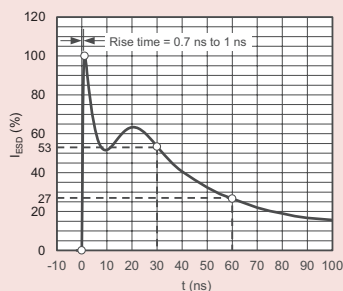
Extremely **tight tolerances** of **$\pm 2.5\%$**

COMPETITIVE ADVANTAGE

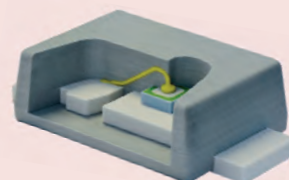
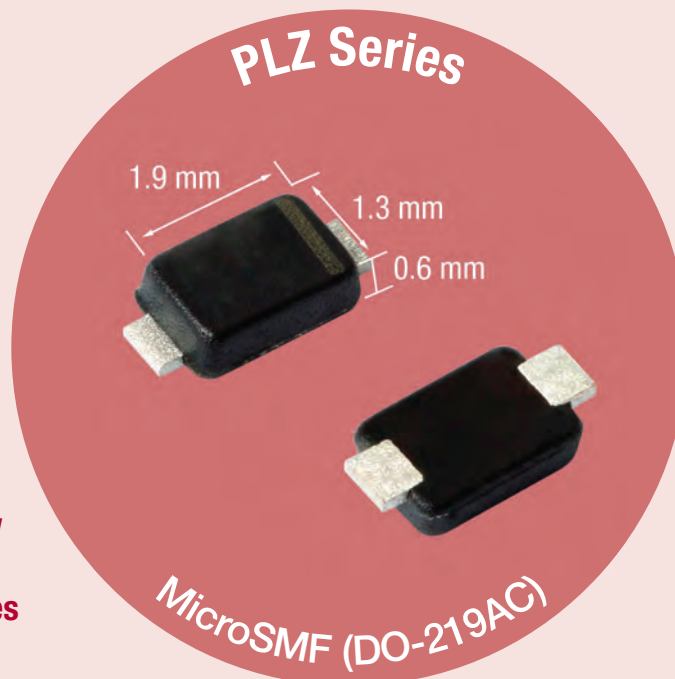
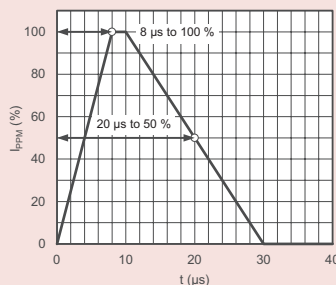
Combining extremely tight tolerances with **low leakage current** and **excellent stability**, the PLZ series is designed to withstand **ESD pulses** of **8000 V** (human body model)

ESD / SURGE CAPABILITY

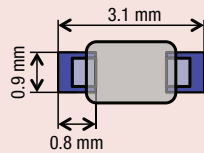
ESD Discharge Current



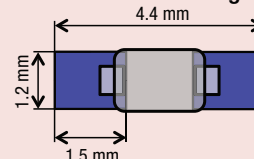
Peak Pulse Current



Reflow Soldering



Wave Soldering



Saves PCB space



Increases pick and place **speeds** on assembly lines

AEC-Q101 qualified

APPLICATIONS

Voltage stabilization and reference voltage generation in power supplies and LED lighting



AUTOMOTIVE



COMPUTERS



TELECOM AND INDUSTRIAL



ELECTRONIC LIGHTING



SWITCHING POWER SUPPLIES

Primary Characteristics

V_Z range nom.	2.0 V to 39 V
Test current I_{ZT}	5 mA to 20 mA
V_Z specification	Pulse current
Int. construction	Single

Datasheet: www.vishay.com/doc?84830

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com



BZD SERIES ZENER DIODES

IN SMF (DO-219AB) PACKAGE WITH SURGE CURRENT SPECIFICATION

IN A NUTSHELL



Full voltage range: **3.6 V to 200 V**
2 % Zener voltage tolerance

Zener and **surge current** specification



Low leakage current

ESD capability to **AEC-Q101**

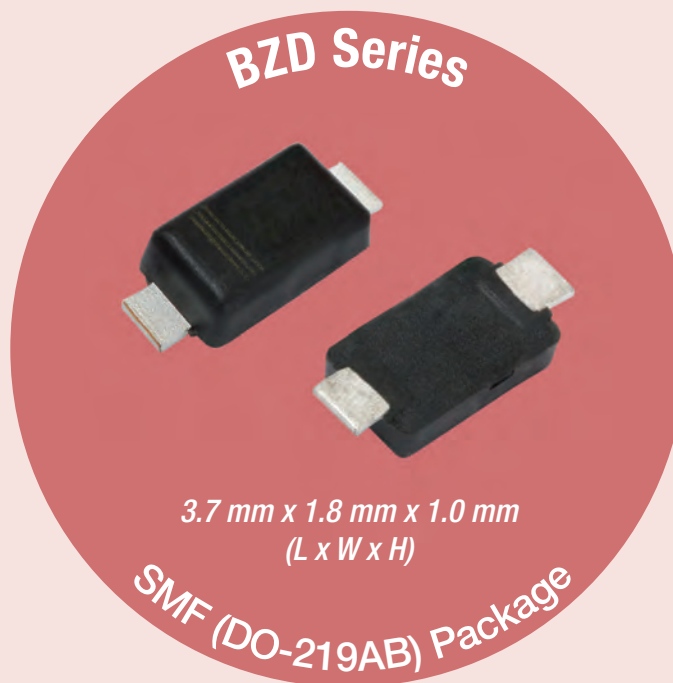
- Human body model > 8 kV
- Machine model > 800 V

RoHS
COMPLIANT

HALOGEN
FREE
Available

AUTOMOTIVE
GRADE
Available

AEC-Q101
Qualified



Operating **temperature** range:
-65 °C to +175 °C



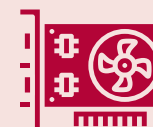
APPLICATIONS



AUTOMOTIVE



ELECTRICAL
LIGHTING



SMPS



INDUSTRIAL

- VOLTAGE STABILIZATION / VOLTAGE REGULATION
- OVERVOLTAGE SURGE PROTECTION

Vishay P/N	Qualification Level	Environmental Status	T _J Max. (°C)	Zener Voltage Tolerance (%)	Zener Voltage Range (V)	Test Current I _{ZT}	V _{BR} (V)	V _{WM} (V)	P _{PPM} (W)	V _Z Specifications	Circuit Configuration	Polarity
BZD27B Series	AUTOMOTIVE GRADE	RoHS-compliant	175	2	3.6 to 200	5 to 100	7.35 to 196	6.2 to 160	150	Pulse current	Single	Uni-directional
BZD27B-M Series	AUTOMOTIVE GRADE	Halogen-free	175	2	3.6 to 200	5 to 100	7.35 to 196	6.2 to 160	150	Pulse current	Single	Uni-directional
BZD27C Series	AUTOMOTIVE GRADE	RoHS-compliant	175	5	3.6 to 200	5 to 100	7 to 188	6.2 to 160	150	Pulse current	Single	Uni-directional
BZD27C-M Series	AUTOMOTIVE GRADE	Halogen-free	175	5	3.6 to 200	5 to 100	7 to 188	6.2 to 160	150	Pulse current	Single	Uni-directional

For Technical Questions: DiodesAmericas@vishay.com, DiodesEurope@vishay.com, or DiodesAsia@vishay.com



AUTOMOTIVE TrenchFET®

SQ SERIES POWER MOSFETS

IN A NUTSHELL

Wide range of **N- and P-channel MOSFETs**

- N-ch $V_{DS} = 12\text{ V to } 300\text{ V}$
- P-ch $V_{DS} = -12\text{ V to } -200\text{ V}$

Available in **single, dual, and dual asymmetric configurations**

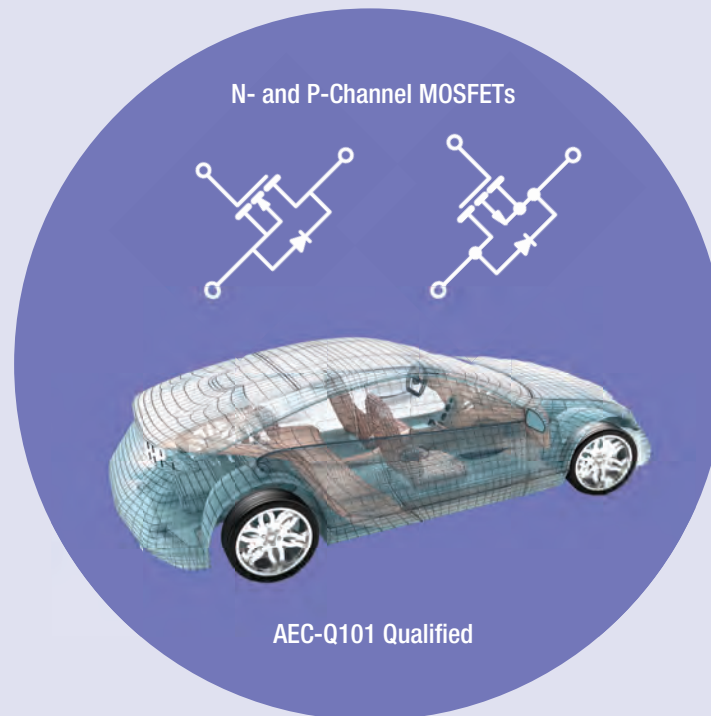
Highly efficient packages with power density up to 11 W/mm^2

- $R_{DS(on)}$ down to **1 mΩ**

AEC-Q101 Qualified to + 175 °C

Latest trench technologies optimized for **low conduction and low switching losses**

Product testing includes extended temp screening with dynamic **PAT, SYL, and SBL** to reduce defects



APPLICATIONS



AUTOMOTIVE



CAR BATTERIES



INFOTAINMENT



LIGHTING

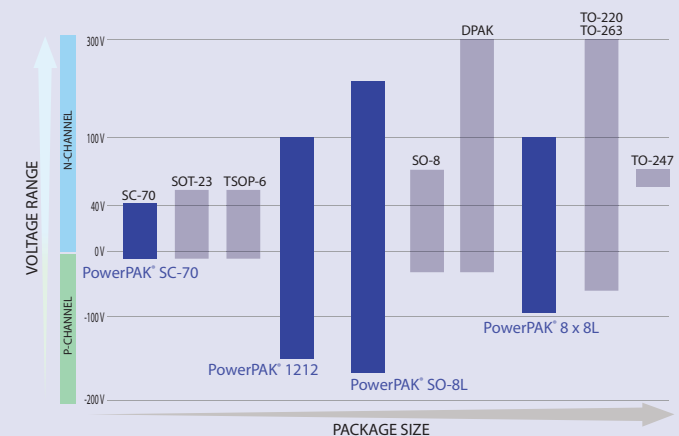


BRAKING



FEV

SQ Package Portfolio



Compact PowerPAK® packages ~ optimized for high board-level reliability

PowerPAK® 8 x 8L 8 mm x 8 mm	PowerPAK® SO-8L 5 mm x 6 mm	PowerPAK® 1212 3.3 mm x 3.3 mm	PowerPAK® SC-70 2 mm x 2 mm	KGD Known Good Die 1 mm x 1 mm to 8 mm x 12 mm

For Technical Questions: automostechsupport@vishay.com



POWER MOSFETs

LOW VOLTAGE TRENCHFET®

IN A NUTSHELL

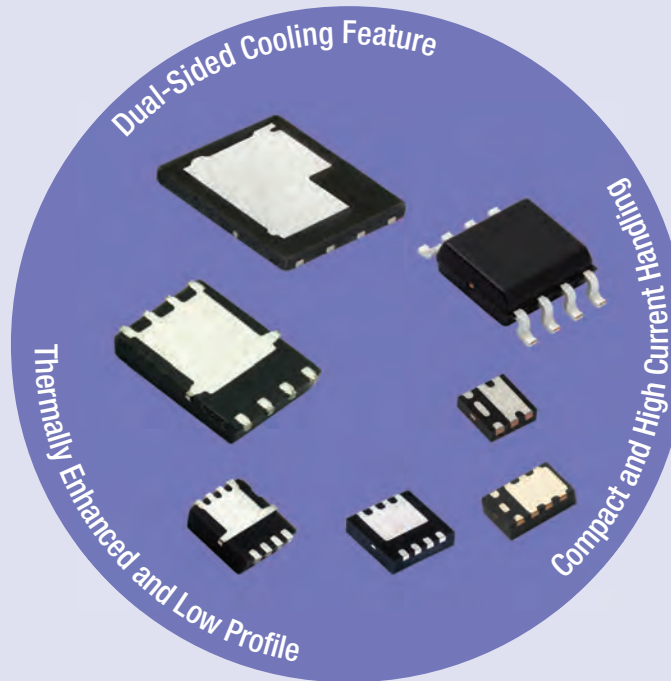
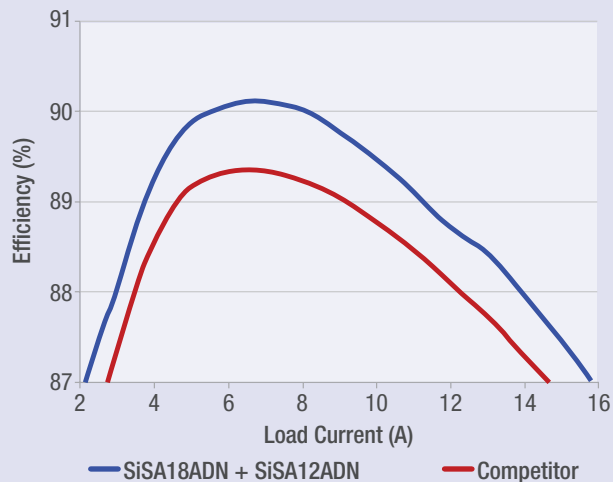


Industry's lowest
 $R_{DS(on)}$ n-channel
MOSFETs in an array
of advanced packages

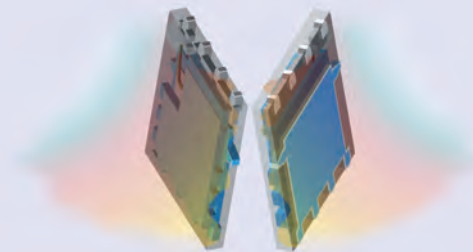
- Less than 0.58 mΩ
- Breakdown voltages: 25 V to 30 V
- Excellent $R_{DS} - Q_g$ FOM improves efficiency for switch mode power supplies

TYPICAL EFFICIENCY IMPROVEMENT EXPECTATION

Benchmarking condition 12.9 V_{IN}, 1.8 V_{OUT}, 800 kHz



Dual-sided cooling feature



Higher efficiency

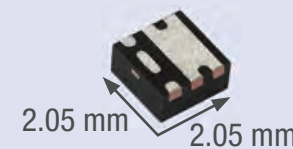


Increased power density

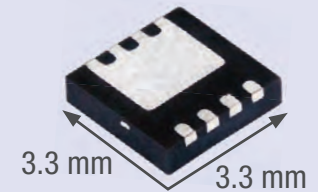
Space-saving packages

SiA468DJ

SiSS02DN



Up to 37.8 A
continuous I_D



< 1.2 mΩ,
10.89 mm² footprint

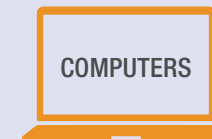
APPLICATIONS



CONSUMER
ELECTRONICS



DRONES



COMPUTERS



SERVERS



TELECOM
EQUIPMENT

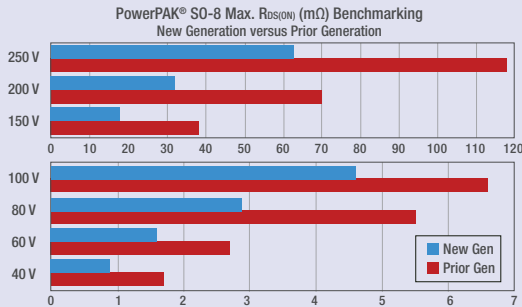


POWER MOSFETs

MEDIUM VOLTAGE TRENCHFET®

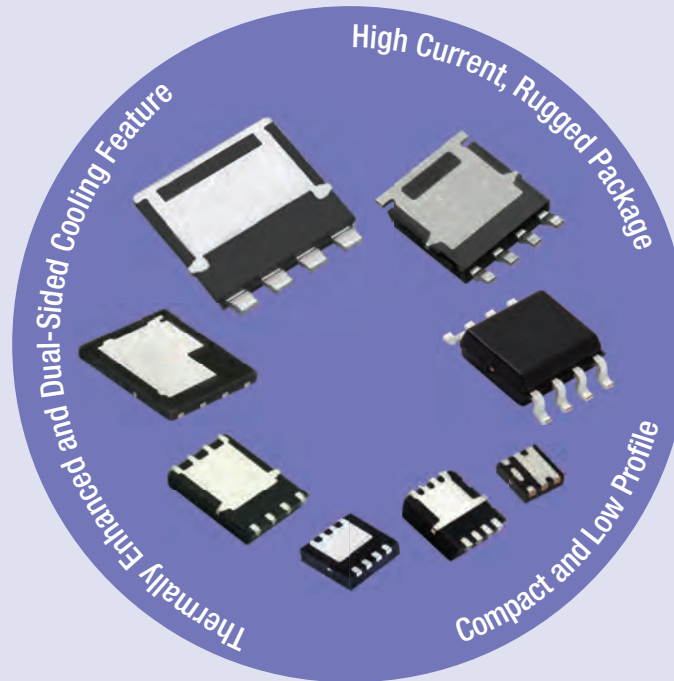
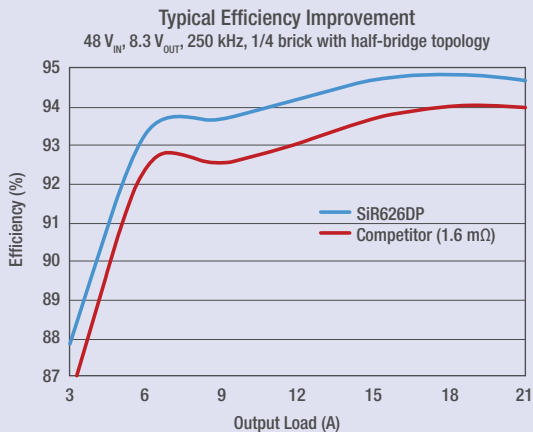
IN A NUTSHELL

Breakdown voltages: **40 V to 250 V**



Industry's lowest $R_{DS} - Q_{oss}$
figure-of-merit (FOM) in an
advanced package array

Excellent dynamic parameters optimize
switching characteristics



Double-cooled PowerPAK SO-8



THIN PROFILE with 0.56 mm typical height
Footprint **COMPATIBLE** to PowerPAK SO-8
 $R_{DS(on)}$ as low as **0.73 mΩ**

Enable the **HIGHEST** efficiency



INCREASE power density

REDUCE component counts



COMPACT and **HIGHLY EFFICIENT**
devices enable layout optimization



80 % footprint reduction from D²PAK
75 % lower package profile

APPLICATIONS



TELECOM
EQUIPMENT



POWER SUPPLIES



MOTOR DRIVE
CONTROL



RENEWABLE
ENERGY



P-CHANNEL MOSFETs

-12 V TO -40 V TRENCHFET® GEN III AND IV

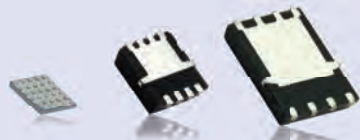
IN A NUTSHELL

Breakdown voltages: **-12 V to -40 V**

Industry's lowest $R_{DS(on)}$

in an array of advanced packages

- Minimize power loss and voltage drop



Part #	Si8851EDB	SiSA01DN	Si7155DP
V_{DS}	-20 V	-30 V	-40 V
$R_{DS(on)}$	< 8 mΩ	< 4.9 mΩ	< 3.6 mΩ
Footprint (mm)	2.4 x 2	3.3 x 3.3	6 x 5

Up to 31 A continuous drain current rating in **2 mm x 2 mm** package

PowerPAK® SC-70

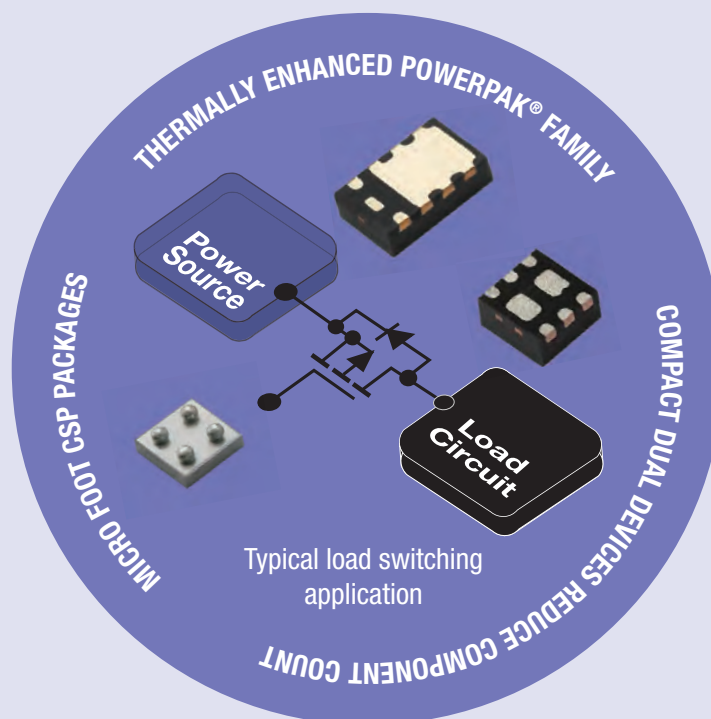
2.05 mm x 2.05 mm x 0.75 mm



Part #	SiA467EDJ	SiA437DJ
V_{DS}	-12 V	-20 V
$R_{DS(on)}$	< 13 mΩ	< 14.5 mΩ
Continuous I_D	31	29.7

Battery application driven features

- Guaranteed **1.5 V** rated $R_{DS(on)}$
- ESD** protection **up to 8 kV (HBM)**



Minimizes Footprint Requirement

Package size down to 0.8 mm x 0.6 mm



MICRO FOOT® **PowerPAK® 0806**
0.8 mm x 0.8 mm 0.8 mm x 0.6 mm

Enable **LONGER** battery life



INCREASE efficiency of power delivery

PREVENT undesired fault signals

COMPACT and space saving PCB layout **OPTIMIZATION**



SiSA01DN

-30 V, 4.9 mΩ
PowerPAK® 1212-8
10.89 mm²



SO-8 equivalent

-30 V, 5 mΩ
SO-8
31 mm²

65 % smaller footprint

APPLICATIONS



BATTERY-POWERED EQUIPMENT



NOTEBOOKS / TABLETS



GAME CONSOLES



CONSUMER ELECTRONICS



WEARABLES

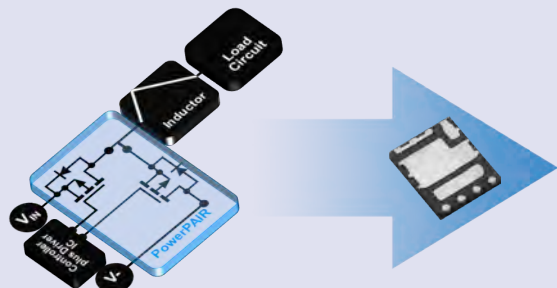


POWERPAIR® MOSFETS

INTEGRATED DUAL-MOSFET POWER STAGE

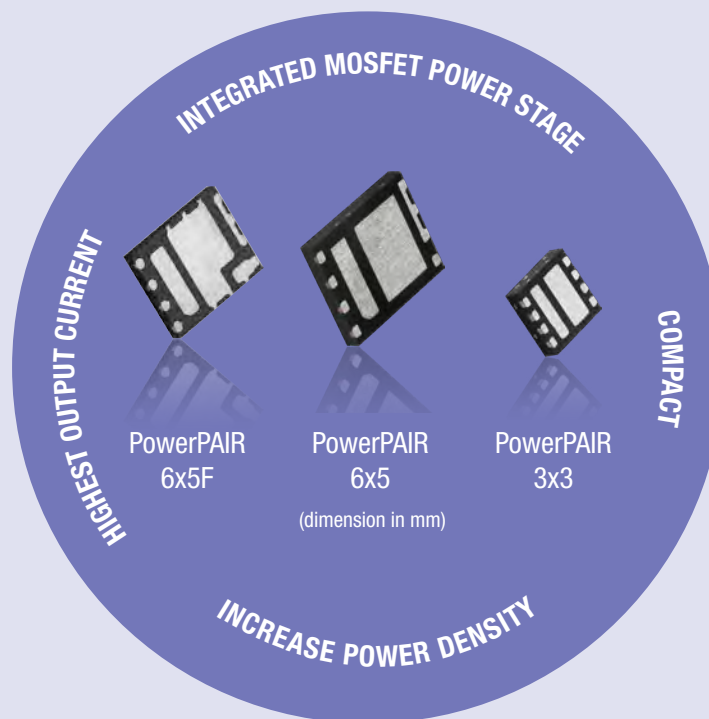
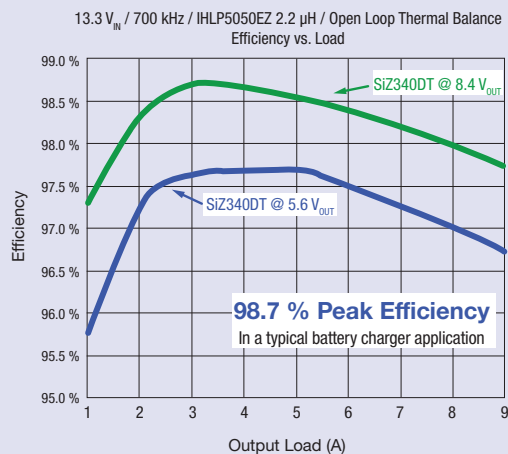
IN A
NUTSHELL

Input Voltage Range: **4.5 V to 24 V**
Internally Connected Half-Bridge



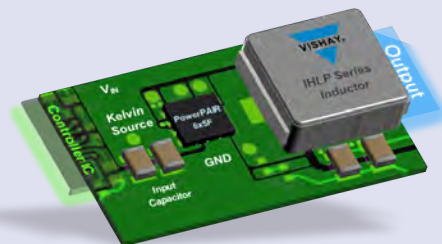
Supports Single or Multi-Phase Designs, Reduces PCB Footprint Area for MOSFET Components

Optimized Gen IV MOSFET Pair
Enables High Efficiency

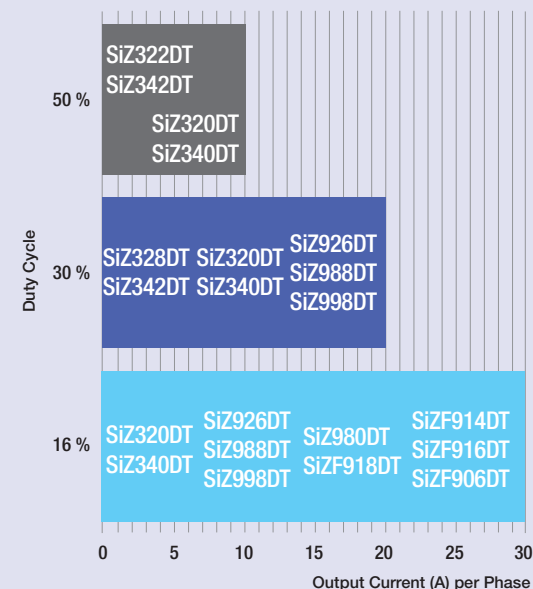


PowerPAIR 6x5F for Layout Optimization

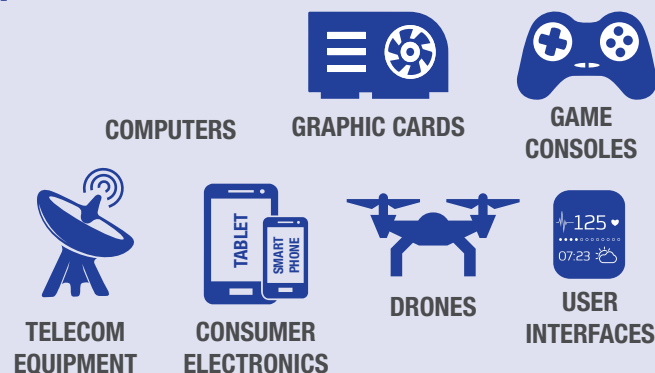
Simplifies Placement of Input Capacitor
Separation of “Power” and “Signal” Partition



WIDE RANGE of Solutions That Support Popular Output Power and Duty Cycle Requirements



APPLICATIONS



For Technical Questions: pmostechsupport@vishay.com



POWER MOSFETs

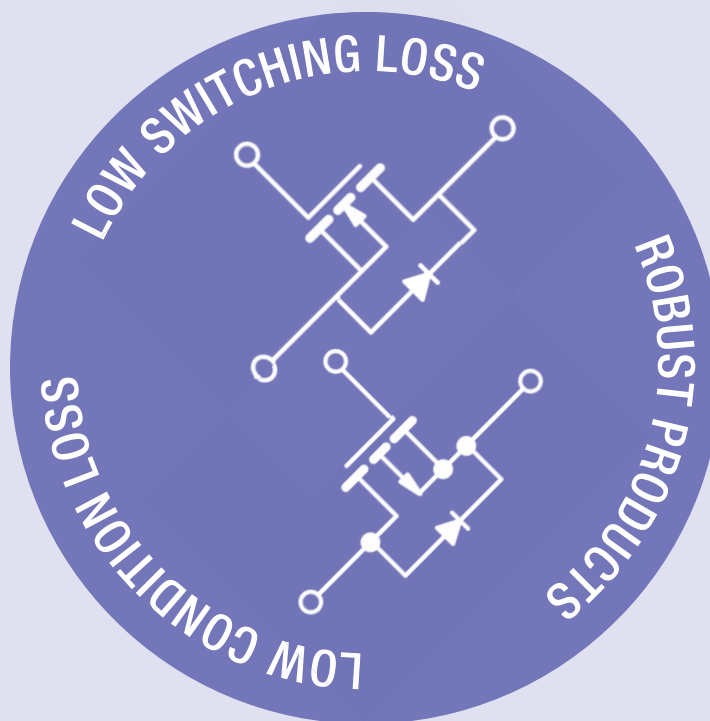
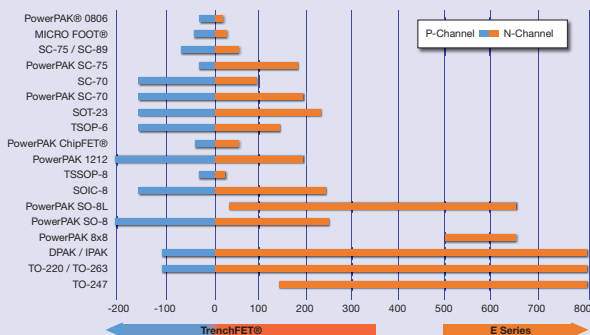
TrenchFET® AND E SERIES

IN A NUTSHELL

Broad range of power MOSFETs in a wide selection of advanced packages

- N- and p-channel families
- Breakdown voltages: -200 V to 800 V
- Wide range of gate drive voltages starting at 1.2 V
- Commercial, automotive, and medical product grades

Breakdown Voltage and Package Selection

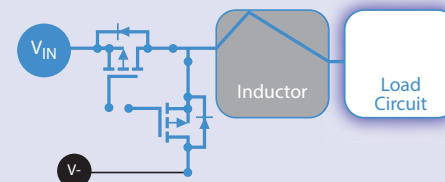


Application-Specific Technology Platforms

- Optimized with lowest $R_{DS(on)}$ for load switch applications



- Optimized for lowest gate charge and capacitances for fast switching



MARKETS AND APPLICATIONS



Full Range Of Leaded and Surface-Mount Packages, Including:

TO-247	D ² PAK / DPAK	PowerPAK® 8 x 8 / 8 x 8L	PowerPAK® SO-8 to 0806	SOT, TSOP, SC Families	MICRO FOOT®



PROXIMITY SENSORS

LIGHT TO DIGITAL – VCNL4x SERIES

IN A NUTSHELL

1.5
m

Presence and **proximity**
sensing up to **1.5 meters**

Programmable emitter current
Upper and lower thresholds, and interrupt
functions
16-bit resolution

0.85
mm

Low profile of **0.85 mm**

Connects directly to a microcontroller via I²C



Fully integrated solutions with
infrared emitter, proximity photodiode,
and signal conditioning IC

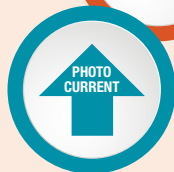
Automotive-qualified options (-X01)



COMPETITIVE ADVANTAGE

- Sensors include 16-bit ambient light sensor at no extra cost
- Optical noise suppression

16 bit



COMPACT PACKAGES

APPLICATIONS

- Mobile devices (e.g. smart phones, touch phones, PDAs, GPS) for touch screen locking, power saving
- Automotive for presence detection
- Attract mode engagement
- Automatic doors, faucets, and toilets
- Robots for cliff detection and docking
- Toys for edge of table detection and collision avoidance



ROBOTS



AUTOMATIC FAUCETS,
DOORS, AND TOILETS



AUTOMOTIVE

Part Number	L	W	H	IR LED	Prox	ALS	Interrupt	Package	AEC-Q101	Range	Remark
VCNL4010	3.9	3.9	0.7	•	•	•	•	FAM		0.2 m	Lowest height
VCNL4020X01	4.9	2.4	0.8	•	•	•	•	FAM	•	0.2 m	Highest operating temperature in market
VCNL3020	4.9	2.4	0.8	•	•		•	FAM		0.2 m	Low height, proximity only
VCNL4040	4	2	1.1	•	•	•	•	PCB		0.2 m	Smallest package in the market. Improved ALS with Filtron™
VCNL4200	8	3	1.8	•	•	•	•	PCB		1.5 m	1.5 meter proximity



VCNL4035X01 GESTURE SENSOR

LIGHT TO DIGITAL PORTFOLIO

IN A NUTSHELL



High resolution **proximity** sensor with a **12- or 16-bit** option

Outstanding sensitivity for object **detection** up to **two feet**



16-bit ambient light sensor **resolution**

COMPETITIVE ADVANTAGE

- Operating temperature range up to 105 °C
- Emitters are discrete versus integrated, allowing customer to configure sensing zone
- Temperature compensation to keep output stable over temperature

Drivers for up to **THREE** emitters



SUPERIOR GESTURE RECOGNITION



Low profile package: 0.75 mm



Greater Design Flexibility

Upper and lower thresholds, and interrupt functions



Excellent background light **cancellation**

HALOGEN FREE

RoHS COMPLIANT

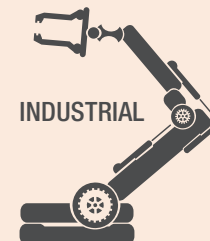
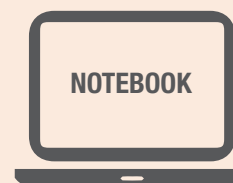
AEC-Q101 Qualified



Incorporates proximity and ambient light photodiodes, multiplexer, signal conditioning, and I²C interface **in a single package**

APPLICATIONS

Ideal for gesture recognition in automotive, consumer, and industrial applications



Primary Characteristics

Operating Range (V)	2.5 to 3.6
I ² C Bus Voltage Range (V)	1.8 to 5
IRED Pulse Current (mA)	up to 200
Ambient Light Range (lx)	0.004 to 4192
Ambient Light Resolution (lx)	0.004
Output Code 16 Bit	I ² C



TRANSMISSIVE SENSORS

SURFACE-MOUNT

IN A NUTSHELL

3 mm Wide gap of 3 mm

Moisture sensitivity level (MSL) of 1
Surface-mount package
Rugged, single piece construction

Output current of **1.6 mA**

1.6 mA

Compact size: 5.5 mm x 4.0 mm x 4.0 mm
Automotive qualified to AEC-Q101

9 μ s Rise time of 9 μ s, typical

Deep slot for **turn and push** function

Operating temperature up to **+125 °C**



TCPT1350X01 / TCUT1350X01



TCPT1600X01 / TCUT1600X01

APPLICATIONS

- Gear shift
- Ignition lock
- Adaptive headlight control
- Climate control knobs
- Latches
- Simple encoders
- Switches
- Motor speed and travel distance



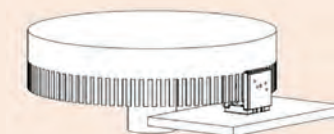
AUTOMOTIVE

COMPETITIVE ADVANTAGE

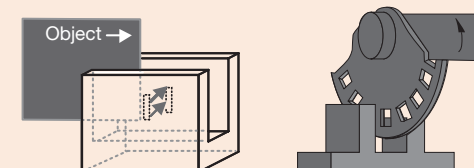
- Extremely high operating temperature
- Package design ensures alignment of emitter and detector
- High photo current output allows lower forward current of emitter



Part Number	TCPT1350X01	TCUT1350X01	TCPT1600X01	TCUT1600X01
Single Channel	•		•	
Dual Channel		•		•
Slot Depth	2.8	2.8	4.5	4.5
L x W x H	5.5 mm x 4 mm x 4 mm		5.5 mm x 4 mm x 5.7 mm	
Function	Presence of object determines speed of turn	Determines speed and direction of turn	Turn and push function presence of object determines speed of turn	Turn and push function determines speed and direction of turn
Gap	3 mm			
Operating Temperature	-40 °C to +125 °C		-40 °C to +105 °C	
Output Current	1.6 mA at I _F = 15 mA			
On / Off Time	9 μs, 16 μs			



How it works: simple encoder drawings



For Technical Questions: sensorstechsupport@vishay.com



TSOP33x, TSOP53x SERIES

OUT PERFORMS FULL LENS PACKAGES

IN A NUTSHELL

Supports IR reflow soldering



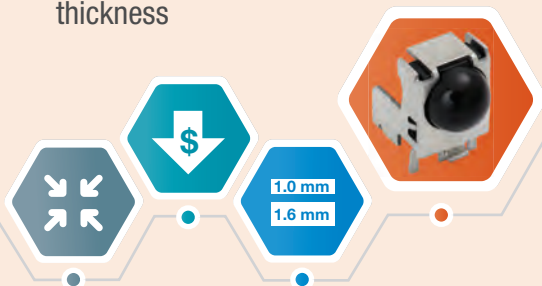
Available in two holder and three bend options, including a top-view surface-mount version

**HALOGEN
FREE**

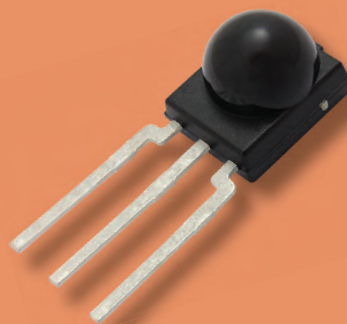
**RoHS
COMPLIANT**

COMPETITIVE ADVANTAGE

- Smaller outline and lower cost than full lens packages
- Robust RF with enhanced optical filter against out of band optical noise
- **Pin in paste capable**
TSOP53xxxP10P or P16P side-view holder for 1.0 mm to 1.6 mm PCB thickness



SMALLER, BETTER, AND LOWER COST



New Minimold Package

45°

Superior angular performance with off-angles up to 45°

Low current consumption



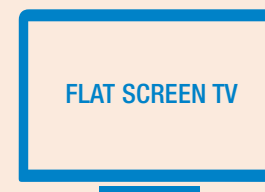
Narrow optical filter option available

Pin to pin compatible with market standard



- All AGC variants are available (36 kHz to 56 kHz)
- TSSP530xx series for mid range sensor applications available
- Several mechanical variants available (holder, bends, and cuts)

APPLICATIONS



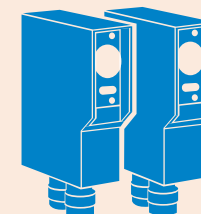
FLAT SCREEN TV



SET-TOP BOXES



STREAMING
MEDIA PLAYERS



LIGHT BARRIERS

Key Specifications	TSOP33xxx	TSOP53xxx
Typical irradiance at 0° (mW/m2)	0.08	0.12
Supply voltage (V)	2.5 to 5.5	
Typical supply current (mA)	0.35	0.7
Transmission range (m)	45	
Carrier frequencies (kHz)	30 to 56	

For Technical Questions: IRR@vishay.com



TSOPx9xxxTR1 SERIES

LOWEST SIDE-VIEW IR RECEIVER PROFILE



IN A NUTSHELL

2 V supply voltage available



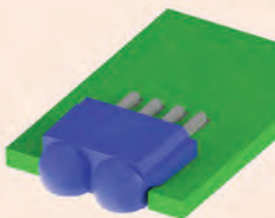
Low profile (2.6 mm)
side-view package

HALOGEN
FREE

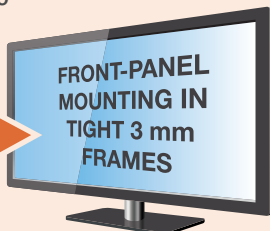
RoHS
COMPLIANT

COMPETITIVE ADVANTAGE

- Winged package for "in the board" mounting
- High sensitivity and long range
- Reflow solderable



TVCastSMD



TVCastSMD



For Pick and Place



Low current consumption

Excellent noise suppression



Very fast response time

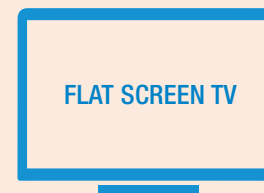
Tape and reel packaging



All AGC variants are available
(36 kHz to 56 kHz)

APPLICATIONS

Ideal for space-constrained electronics



FLAT SCREEN TV



SET-TOP BOXES



STREAMING
MEDIA PLAYERS

PRIMARY CHARACTERISTICS

Dimensions Width, Height, Depth (mm)	6.8 x 2.6 x 5.3
Supply Current (typ)	0.35 mA
Minimum Irradiance (typ)	0.08 mW/m ²



SOLID-STATE RELAYS

VOR SERIES

IN A NUTSHELL

High reliability and noiseless switching (no click)



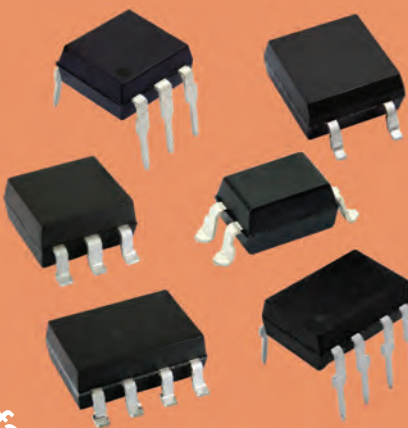
Tiny footprint relative to **electro-mechanical** relays

Fast switching times



Low on-resistance, down to **12 Ω** (typ.)

Compact Packages



Surface-Mount and Through-Hole

APPLICATIONS



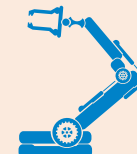
SECURITY SYSTEMS



BATTERY MANAGEMENT



AUTOMATIC MEASUREMENT EQUIPMENT



INDUSTRIAL



METERING



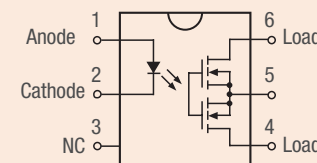
TELECOMMUNICATION



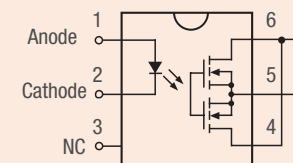
INSTRUMENTATION

AC AND DC CONFIGURATION WITH SSRs

AC/DC Configuration



DC-Only Configuration



	VOR1121A6	VOR1121B6	VOR2121A8	VOR2121B8	VOR1142M4	VOR1142B4	VOR1142A6	VOR1142B6	VOR2142A8	VOR2142B8
Single / Dual Channel	Single	Single	Dual	Dual	Single	Single	Single	Single	Dual	Dual
Package	DIP-6	SMD-6	DIP-8	SMD-8	SOP-4	SMD-4	DIP-6	SMD-6	DIP-8	SMD-8
Isolation Test Voltage ($V_{RMS}/1 \text{ min}$)	5300	5300	5300	5300	3750	5300	5300	5300	5300	5300
Typical On-Resistance (Ω)	12	12	12	12	22	22	22	22	22	22
Load Voltage (V)	250	250	250	250	400	400	400	400	400	400
Typical Turn-On Time (ms)	0.2	0.2	0.2	0.2	0.2	0.13	0.13	0.13	0.13	0.13
Typical Turn-Off Time (ms)	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05



LARGE PIN PHOTO DIODES

7.5 mm² ACTIVE AREA

Radiant sensitive area of **7.5 mm²**



High photo sensitivity

Low profile of **0.9 mm**

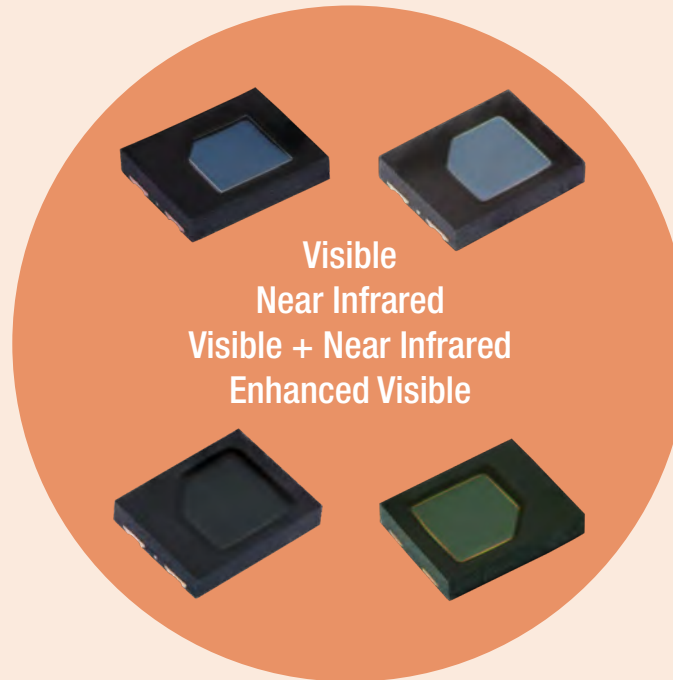


Rise and fall time down to **5 ns**

Excellent **photocurrent linearity**

Narrow variance of **output current**

from part to part



IN A NUTSHELL

APPLICATIONS

Wearables

- Fitness bands
- Smart Watches



Medical

- Pulse Oximetry
- Blood Analysis

Automotive

- Rain-Light-Tunnel Sensor
- Solar sensor



Part Number	Spectral Bandwidth (nm)	Peak Wavelength λ_p (nm)	Output Current (μA)	Angle of Half Sensitivity, ϕ (\pm deg)	Photo Sensitive Area (mm ²)	Package Dimensions L x W x H (mm)	Competitive Advantages	
VEMD5010X01	430 to 1100	940	48	65	7.5	5 x 4 x 0.9	AEC-Q101 qualified	Unique FAM packaging allows for high operating temperature up to +110 °C
VEMD5060X01	350 to 1070	820	26				Fastest rise and fall times. AEC-Q101 qualified	
VEMD5080X01	350 to 1100	950	45				Enhanced sensitivity to visible light. AEC-Q101 qualified	
VEMD5110X01	790 to 1050	940	48				Daylight blocking filter. AEC-Q101 qualified	
VEMD5160X01	700 to 1070	840	26				Daylight blocking filter with fastest rise and fall times. AEC-Q101 qualified	
VEMD5510C	440 to 700	550	0.6				Not sensitive to infrared radiation	
VEMD5510CF	440 to 620	540	0.25				Not sensitive to infrared radiation and matches human eye sensitivity	



SiC46X and SiC47X microBUCK® SERIES

4.5 V TO 60 V BUCK REGULATORS

IN A NUTSHELL

200 W



OUTPUT POWER

4.5 V to 60 V **buck regulator** capable of delivering up to **200 W output power**

COMPETITIVE ADVANTAGE

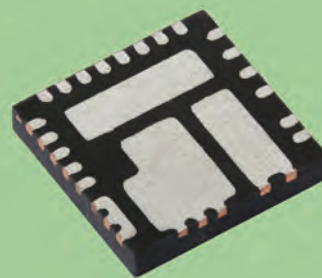
Highly Integrated

Competition



Compact,
Efficient
SiC46x
SiC47x

DELIVERING UP TO 200 W OUTPUT POWER



2 to 12 A buck regulators
in a compact MLP
5x5 package

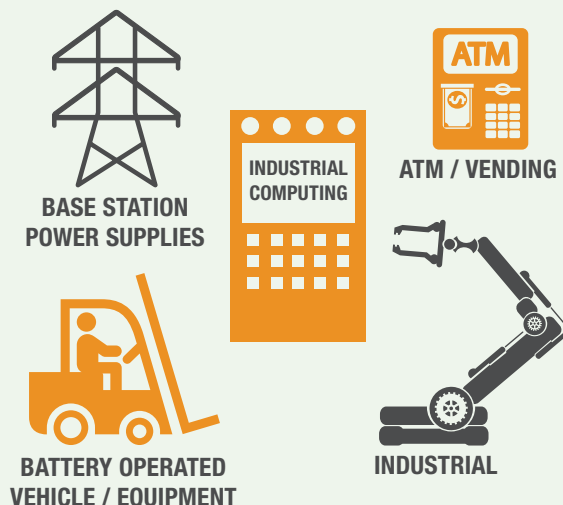


Rugged and Reliable

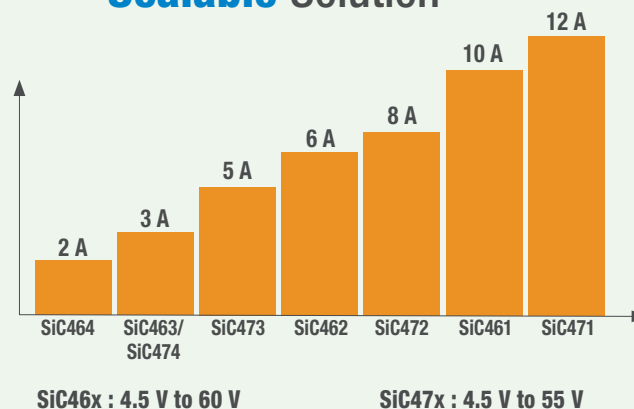


APPLICATIONS

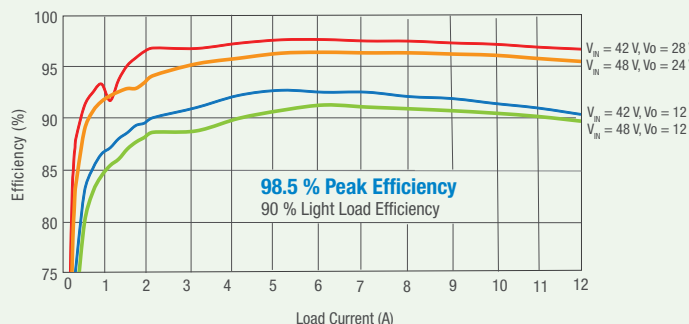
Design your application using our [online PowerCAD Simulation Tool](#)



Scalable Solution



Measured Efficiency for SiC471 @ Fsw=300kHz



For Technical Questions: powerictechsupport@vishay.com

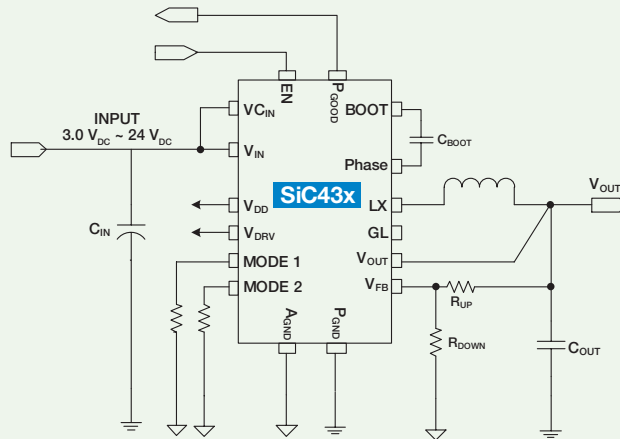


SiC43X: 3 V TO 24 V microBUCK®

8 A TO 24 A FAMILY ENABLES HIGH POWER DENSITY AND EFFICIENCY

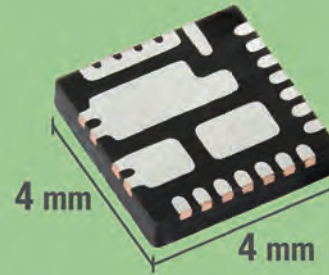
IN A NUTSHELL

COMPACT AND SIMPLE



Minimum external components;
Two resistors set soft start, switching frequency,
ILIMIT, and operating mode

INTERNALLY COMPENSATED



Compact PowerPAK®

With the Widest Operating Range

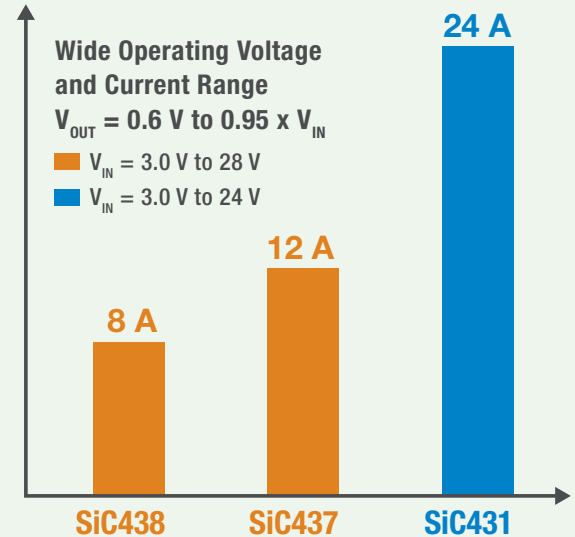
VERSATILE

Wide Operating Voltage
and Current Range

$$V_{OUT} = 0.6 V \text{ to } 0.95 \times V_{IN}$$

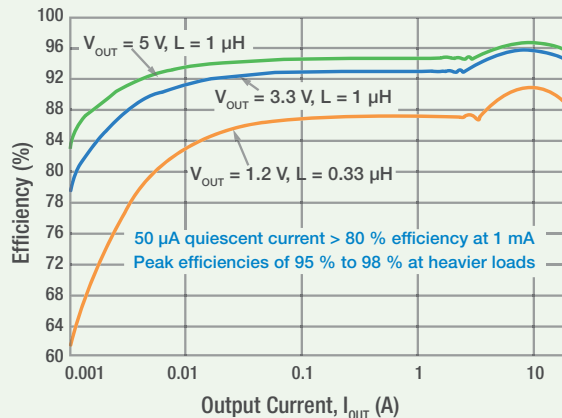
Orange bar: $V_{IN} = 3.0 V \text{ to } 28 V$

Blue bar: $V_{IN} = 3.0 V \text{ to } 24 V$



HIGHLY EFFICIENT

SiC431 Efficiency From 12 V



APPLICATIONS



PORTABLE

Tablet PCs
Ultrabooks
Notebooks



HOME ENTERTAINMENT

Streaming Media
Boxes
Televisions



INFRASTRUCTURE

Line Cards
Modems
Transmitters /
Base Stations
AC/DC SMPS



COMPUTING AND PERIPHERALS

Servers
Embedded Systems
SSD
UPS
Networking
Printers



GAMING

Game Consoles
Portable Game
Consoles
Accessories /
Controllers /
Steering Wheels



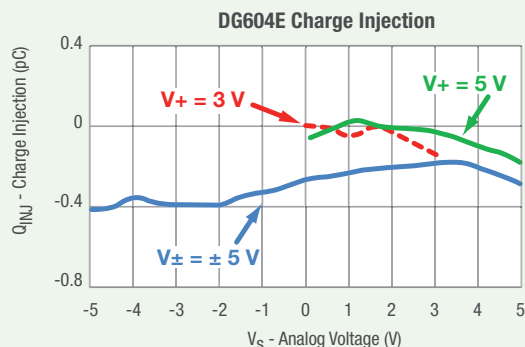
ANALOG SWITCHES AND MULTIPLEXERS

$\pm 3\text{ V TO } \pm 15\text{ V}$, $1.8\text{ V TO } 24\text{ V}$ ENHANCED PRECISION SERIES

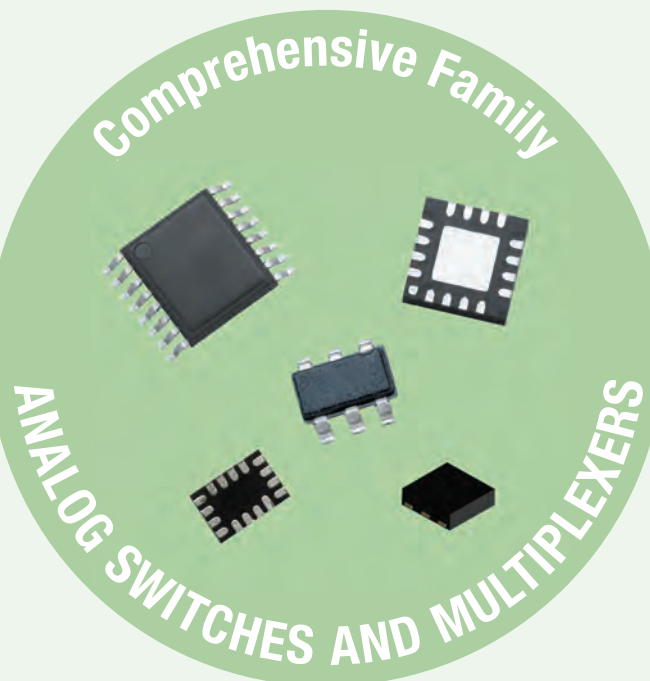
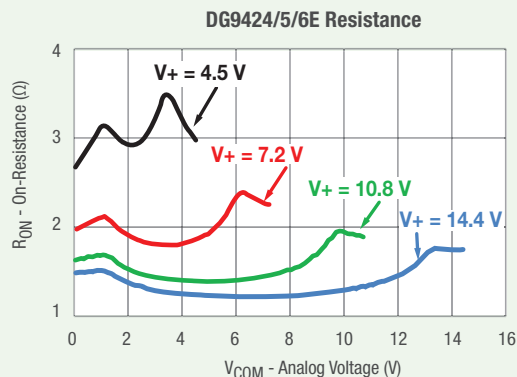
IN A NUTSHELL

From **ultra low charge** injection to **ultra low resistance**, Vishay's **Enhanced Series** analog switches have your **precision designs** covered

Ultra low charge injection
higher accuracy and faster speed

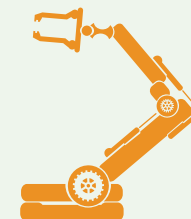


Low resistance Low insertion loss

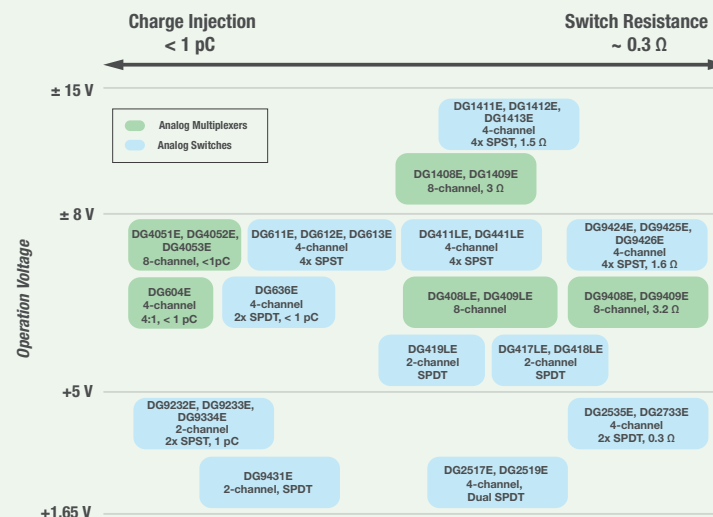


- **Rugged** reliability
- Power down **protection**
- **High** ESD and latch up levels

APPLICATIONS



INDUSTRY'S BROADEST VOLTAGE RANGE AND CHOICE OF CONFIGURATIONS

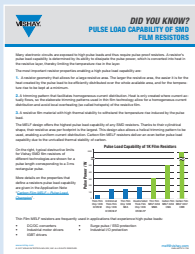




DID YOU KNOW?

Vishay also offers a library of one page articles called “Did You Know” that are written by our engineering support teams and provide tips on product performance to assist design engineers in product selection.

They typically cover raw material, construction advantages, and/or specific tips to ensure designers are able to maximize board performance or minimize component count and or board real estate.



Links to these articles are located in the infographics landing page area.

www.vishay.com/ref/infographics





CAPABILITIES AND CUSTOM OPTIONS

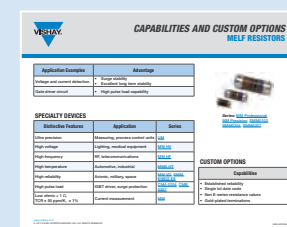
Though Vishay offers nearly two million parts to our customers, there are still many occasions where designers require modifications to existing parts or fully custom designs to meet their specific mechanical or electrical requirements.

To assist, we offer a library of **“Capabilities and Custom Options”** documents in the infographics landing page area.

Where available, these provide information about available construction styles (including lead attachments, and lengths, etc.), testing, and other capabilities to better match the unique needs of the designer. **Contact our sales team for further information**

Links to these articles are located in the infographics landing page area.

www.vishay.com/ref/infographics





LEARN HOW VISHAY TECHNOLOGIES CAN GIVE YOU A COMPETITIVE ADVANTAGE

Capabilities and custom options, 3D models, application notes, design tools, videos, and more

A **WORLD OF**
SOLUTIONS™